PEAK TORQUE POST CONVENTIONAL ROTATOR CUFF REPAIR COMPLEMENTED BY THE AID OF MESENCHYMAL AUTOLOGOUS STEM CELLS

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SUMMARY
The purpose of this study was to investigate the peak torque of rotator cuff muscle tears treated by a conventional repair technique with the aid of mononuclear autologous bone marrow stem cells. Twenty patients with complete rotator cuff tears had their muscle tears fixed by transosseous stitches performed through a mini-open incision. After surgical repair, the tendon of twelve patients was injected with mononuclear autologous stem cells that were obtained from their iliac crest just prior to shoulder surgery. The isometric and isokinetic peak torque of the shoulder rotators was evaluated after one year of surgery and rehabilitation. The isometric and isokinetic peak torque was compared between the experimental group (11 subjects post-shoulder surgery and stem cell treatment) and the control group (9 subjects post-surgery without stem cell treatment). The independent t-test revealed a difference between groups for isometric peak torque ($p=0.031$) and isokinetic peak torque ($p=0.036$). The experimental group showed higher peak torque compared to the control group. These results suggest that stem cell treatment improves rotator cuff tear repair as shown by the higher peak torque when compared with the subjects undergoing the same surgical procedure without the addition of stem cells.

INTRODUCTION
Rotator cuff injuries are more common after the fourth decade of life and, in most cases, it is due to tendon avascular degeneration (1) which is responsible for the high rate of postoperative re-tear. Muscle imbalance between the internal (IR) and external rotators (ER) is usually associated with the tendon injury. The ER are activated during shoulder internal rotation in an attempt to prevent excessive translation and to stabilize the humerus (2). These functional alterations of the rotators cuff cause joint instability and overload, resulting in increased injury risk and re-rupture (3).

The surgical treatment, with or without acromioplasty, is the treatment of choice. A major problem arises from the fact that many patients undergoing surgery already show advanced degeneration of the tendons, which are thinner and atrophic. For that reason, re-tear is a common complication after surgery. In recent years the use of stem cells for the degenerative pathologies treatment has been studied and the capacity of replication and differentiation of these cells is well known. A strategy aiming at revitalizing the tendon structure would probably overcome this complication, by increasing the tendon resistance to muscle traction. The purpose of this study was to evaluate the isometric and isokinetic muscle peak torque of the shoulder rotators after one year of reconstructive surgery of the rotator cuff with the application of autologous bone marrow mononuclear cells during tendon recovery (4).

METHODS
Twenty subjects with complete rotator cuff rupture participated in the study. The experimental group (EG) consisted of 11 subjects that accepted participate of the evaluation of the 14 operated (4 women and 7 men; age: 58.0 ± 7.5years; body mass: 73.4 ±11.9 kg; height: 160.4 ± 8.8cm). The control group (CG) consisted of 9 subjects operated in the same period and were call random (2 women and 7 men; age: 55.5 ± 7.6 years; body mass: 70.3 ± 11.6kg; height: 156.1 ± 6.8cm). The 20 subjects with complete rotator cuff tear were treated by a conventional repair technique and their injury was fixed by transosseous stitches performed through a mini-open incision. The EG had the addition of mononuclear autologous bone marrow stem cells to the tendon repair.

Prior to the orthopedic procedure, bone marrow mononuclear cells were obtained. During the preparation of the mononuclear cell suspension, the patient was placed in the beach-chair position and the surgery was initiated. All patients underwent acromioplasty for an increase in the subacromial space. The tendon-tendon and tendon-bone sutures were performed with Ethibond 5/0. After closure of the lesion, 10ml of the cell concentrate were injected in the tendon and bone in subjects of the EG. After plan closure, all patients were immobilized in a sling for 4 weeks. Physical therapy was initiated after the fourth week in a conventional rehabilitation protocol.

One year after surgery and rehabilitation, subjects underwent muscle strength evaluation. All subjects performed maximal isometric contraction of internal and external rotators and isokinetic maximal internal and external rotation. Shoulder internal and external rotation performances were measured using reciprocal motions of internal and external rotation with the shoulder at 0^o of glenohumeral joint abduction in the coronal plane and the elbow at 90^o flexion. Isokinetic testing was performed with 0-60^o of external rotation and 0-60^o of internal rotation. The isokinetic internal and external rotator

muscle strength was tested at 60°/s concentrically. The sequence performed for each test consisted of three submaximum repetitions of the movement for familiarization, followed by three repetitions at 60°/s and then 3 maximal isometric contractions, with a 2-min rest between contractions. The shoulder torque rotation was measured with an isokinetic dynamometer (Biodex Medical System, Shirley – NI, USA). The isometric and isokinetic torques were compared between the experimental and the control group with an independent T-Test, with a 0.05 level of significance.

RESULTS AND DISCUSSION

The shoulder external rotators isometric peak torque was lower (p=0.031) for the CG (9.3 ± 6) compared to that of the EG (20.3 ± 13.1) (mean ± SD). The isokinetic peak torque for the CG (9.7 ± 6.5) was also smaller (p=0.036) when compared to that of the EG (18.5 ± 10.2), as shown in the table 1.

Table 1: Peak torque during isometric external and internal rotations of the shoulder, and during isokinetic external and internal rotations.

	CONTROL GROUP (N = 9)	EXPERIMENTAL GROUP (N = 13)
ISOMETRIC PEAK TORQUE (Nm)	9.3 ± 6.0	20.3 ± 13.1 *
ISOKINETIC PEAK TORQUE (Nm)	9.7 ± 6.5	18.5 ± 10.2 *

Results are mean ± standard deviation

*** p<0.05, compared to the peak torque between control group and experimental group**

Peak torque values for the subjects with rotator cuff injuries have been reported as varying between 14-89 Nm (3) and the peak torque after the surgery is changed with more muscle imbalance being observed in these patients (5). Our results for the CG are smaller than those reported in the literature, whereas the EG showed results within the reported range. The difference here observed between CG and EG might be explained by the cicatrisation and the regeneration, which might have occurred in a better way in the EG probably because of the mononuclear autologous stem cells treatment (4,6). Studies have been conducted with use of the stem cell in cardiology, neurology, dentistry, and so forth. There are, however, few publications in the orthopedic field (6), particularly on the use of bone marrow mononuclear cells for the recovery of tendons in rotator cuff tears.

CONCLUSIONS

Patients undergoing stem cell treatment post rotator cuff tear surgery improved their muscle strength compared to patients that underwent just the traditional rotator cuff repair surgery.

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