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Serum creatine phosphokinase levels as an indicator of muscle injury following lumbar disc surgery: Comparison of fully endoscopic discectomy and microdiscectomy

Mehmet Osman Akçakaya[a,*], Ali Güven Yörükoğlu[b], Aydın Aydoseli[c], Yavuz Aras[c], Pulat Akın Sabancı[c], Muhittin Emre Altunrende[c], Müge Dolgun[c], Burcu Göker[a], Fahir Şencan[c], Achmet Ali[d], Altay Sencer[c]

[a] Department of Neurosurgery, Liv Hospital, Istanbul, Turkey
[b] Department of Neurosurgery, Private Asia Hospital, Istanbul, Turkey
[c] Department of Neurosurgery, Istanbul School of Medicine, Istanbul University, Istanbul, Turkey
[d] Department of Anethesiology and Reanimation, Istanbul School of Medicine, Istanbul University, Istanbul, Turkey

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ABSTRACT

Objective: The aim of this study is to make a comparison between fully endoscopic lumbar discectomy (FELD) and conventional microdiscectomy (MD) by using pre- and postoperative serum creatine phosphokinase (CPK) levels in correlation with postoperative low-back pain.
Methods: Fortyfive consecutive patients who underwent surgery for lumbar disc herniation were allocated into three groups with 15 patients on each: (1) FELD with interlaminar approach (IL), (2) FELD with transforaminal approach (TF), (3) Conventional MD. Serum CPK levels pre- and 1, 6, 12 and 24 h postoperatively, patients' body mass index (BMI), operation duration and hospital stays were recorded. The low-back pain pre- and postoperatively was assessed with the use of the 100 mm visual analog scale (VAS) and the "Oswestry Disability Index" (ODI).
Results: There were 16 female (35.5%) and 29 male (64.5%) patients with a mean age of 44.1 years. CPK levels at 6th, 12th and 24th hours postoperatively were found significantly lower in TF and IL groups compared to MD group ($p < 0.004$). Mean operation duration was significantly shorter in MD group (p: 0.014). There was a significant decrease in both the VAS and ODI scores after the surgery in all patient groups ($p < 0.001$). Postoperative VAS scores were found significantly higher in MD group (p: 0.04).
Conclusion: Minimal invasive nature of FELD procedures compared to the MD was substantiated by serum CPK levels in this study. To draw definitive conclusions regarding pain relief, larger patient samples should be evaluated, although postoperative VAS scores were found in favor of FELD.

1. Introduction

Microdiscectomy (MD) has become the gold standart surgical technique in the management of lumbar disc herniations and it is still used as the most common procedure. However, minimal invasive procedures to the lumbar spine has gained a growing attention in the last decade. Good clinical outcomes comparable to MD have been reported both for microendoscopic [5,25] and full-endoscopic [1,8,9,16,19–23,25,29] techniques. With similar success rates compared to MD, the most important advantages of these techniques are claimed to be small surgical access, less muscle damage, reduced epidural scarring and early recovery of the patients [22,23]. Iatrogenic injury to paravertebral muscles has been postulated as a major cause of persistant low back pain following microdiscectomy [14]. The degree of invasiveness of microendoscopic discectomy compared to open discectomy or MD has been assessed in various studies by using serum levels of different biochemical markers such as creatine phosphokinase (CPK), C-reactive protein(CRP), Interleukin 1β (IL-1β), Interleukin 6 (IL-6), Interleukin 8 (IL 8), Interleukin 10 (IL-10) and tumor necrosis factor α (TNF-α) [3,7,24,26]. However, there are no publications with comparison between fully endoscopic lumbar discectomy (FELD) and MD regarding the degree of iatrogenic muscle injury to the best of

* Corresponding author at: Liv Hospital Ulus, Ahmet Adnan Saygun Ave. Canan Street, no:5, Besiktas, Istanbul, Turkey.
E-mail address: moakcakaya@gmail.com (M.O. Akçakaya).

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our knowledge. The aim of the current study was to make an objective comparison between FELD and MD in terms of invasiveness, with evaluation of iatrogenic muscle injury by measuring changes between pre- and postoperative serum CPK levels in correlation with patients' postoperative low-back pain.

2. Material and methods

Forty-five consecutive patients, who underwent surgery for lumbar disc herniation were included to the study. Patients with known inflammatory myopathy, with a musculoskeletal injury, with a history of excessive exercise within the last 7 days before sampling and drug abuse were excluded from the study. Three different surgical approaches were chosen for these patients as they may be allocated in three groups with 15 patients on each: FELD with interlaminar approach (IL), FELD with transforaminal approach (TF) and conventional MD. The indications for choosing the surgical approach between FELD and MD did not alter from each other. However, the selection of TF versus IL approach was made according to the principles previously defined by Ruetten et al. [20,22,23]. The TF approach has known anatomic limitations. Therefore, the IL approach was chosen in patients with the following characteristics: (a) sequestering material had migrated beyond the lower edge of the cranial pedicle or over the middle of the caudal pedicle, and (b) the foramen was overlaid by the iliac crest on lateral plain radiographs [20,22,23].

The low-back pain was assessed with the use of the 100 mm visual analog scale (VAS) which varies from 0 mm refers to "no pain" to 100 mm refers to "worst imaginable pain". In addition to pre- and postoperative VAS testing, the Turkish version of the "Oswestry Disability Index" (ODI) was also used to evaluate clinical outcomes and pain relief [6]. Preoperative and postoperative serum CPK levels were measured with the employment of enzyme-linked immunosorbent assay (ELISA) before the surgery and at the 1st, 6th, 12th and 24th hours following the surgery. Body mass index (BMI) of the patients, duration of the operation and mean hospital stays of patients were also recorded.

3. Surgical technique

All procedures were performed under general anesthesia. MD was performed according to the method described by Love, Yasargil and Williams with some modifications [4,27,28]. The patient is placed on the operating table in prone position. With c-arm fluoroscopy control the confirmation of the correct intervertebral disc space with a radiopaque skin marker is obtained. A 25 mm long midline skin incision is made. The paravertebral muscle fascia is incised paramedianly and a subperiostal muscle dissection is performed. A Taylor retractor was used to maintain the exposure by holding the muscles laterally over the facet joint. Under microscopic visualization a standart discectomy and foraminotomy was performed. Following the hemostasis, fascia and skin is closed with absorbable suture materials.

For both endoscopic approaches (TF and IL approach) same surgical techniques were performed as previously described by Ruetten et al. [19–23]. The patient is placed on the operating Table in the prone position. The c-arm is positioned under the operating Table to allow sterile biplanar fluoroscopic control. For both approaches, the skin incision is first marked. For TF approach, the skin incision is located 10–14 cm from the midline, in order to obtain tangential access to the spinal canal. Under fluoroscopic control, a 1.5 mm blunt spinal cannula is inserted; through this, a 0.8 mm guidewire is then inserted. The cannula is removed, and a cannulated dilator (with an outer diameter of 6.9 mm) is inserted using the guidewire. The guidewire is then removed, and with this blunt dilator, the position can be fixed more safely under fluoroscopic control. A surgical sheath (with an outer diameter of 7.9 mm) with a bevealed opening is placed over the dilator (Fig. 1). Then, using a direct endoscopic view and continuous irrigation, discectomy is performed. The skin incision for the IL approach is made as medial to the midline of the targeted interlaminar space as possible. The cannula, guidewire and dilator was again inserted as described above. Then, discectomy was performed under direct endoscopic view (Fig. 2). After removal of the endoscope, the wound is closed with the use of a single 2/0 prolene suture.

4. Statistical analysis

A non-parametrical test, *t* test was used for statistical analysis. Operation time, BMI findings, CPK values, pre- and postoperative VAS and ODI scores were compared using Chi-Square test (quality of variations) and Kruskal-Wallis test (quantity of variations) in means of median and range. Descriptive assessments and analytical statistics were calculated, depending on the group's characteristics, using SPSS 16. A positive significance level was assumed at a probability of less than 0.05.

5. Results

There were 16 female (35.5%) and 29 male (64.5%) patients in our study group. The mean age of the patients was 44.1 years (range 19–78 years). There were no differences in the mean age and gender predominancy among the three patient groups. The mean BMI of the patient group was 26.7 (range 21–42 kg/m^2). No statistically differences were found among the patient group by means of BMI scores. The mean duration of the operation on average was enlisted as 71 min for the MD group, 91 min for the IL group, 94 min for the TF group. The mean operation duration time in MD group was found to be significantly shorter compared to the other two groups (p: 0.014). However, the operation duration did not significantly differ between the two groups of endoscopic technique, namely TF and IL groups (p: 0.786). Mean hospital stay of the patient group was 1.13 days (range 1–3 days). There a tendency for a longer hospital stay in MD group (1.2 days) compared to the other groups, however this difference was not statistically significant (p: 0.809). The patients BMI scores, duration of surgery and mean hospital stays with respect to the patient groups are shown in bar charts (Fig. 3).

The mean preoperative VAS and ODI scores were found 86.6/100 mm and 37.7 respectively. Preoperative VAS and ODI scores showed no statistical difference among the patient groups. There was a significant decrease in both the VAS (74.6%) and ODI (64.5%) scores after the surgery in all patient groups ($p < 0{,}001$). Postoperative VAS scores were found significantly higher in MD group (p: 0.04), whereas ODI scores were found higher in MD group when compared to the other two groups, with no statistically significant difference (p: 0.195) for ODI scores. The results for pre- and postoperative VAS and ODI scores are shown in bar chart (Fig. 4).

Preoperative serum CPK levels was found 91.6 U/L in IL, 94.3 U/L in TF and 118.7 U/L in MD groups. No statistically significant differences were found among the three groups. Postoperative CPK levels at 1st, 6th, 12th and 24th hours were recorded. No statistically significant differences were found for MD compared to the other two groups (p: 0.452) by means of postoperative 1st hour CPK level. However, CPK levels at 6th, 12th and 24th hours postoperatively were found significantly lower in TF and IL groups compared to MD group ($p < 0.004$). No significant differences were found for CPK levels between TF and IL groups, although we have noticed greater CPK values for IL group compared to TF group. The pre- and postoperative CPK values are shown in line chart (Fig. 5).