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Short Communication

Global Functional Evaluation of Elbow after Radial Head Prosthesis: Isokinetic Testing Interest and Validation

Marie Le Mapihan Marie[1]*, Gaëlle Ouvrard[2], Philippe Thoumie[2], and Emmanuel H. Masmejean[3]

[1]Hand, Upper Limb and Peripheral Nerve Surgery Service, Georges-Pompidou European Hospital (HEGP), France

[2]Department of Hôpital Rotschild, - University of Paris, France

[3]Clinique Saint-Geneviève, University of Paris, France

***Corresponding author**

Marie Le Mapihan, Hand, Upper Limb and Peripheral Nerve Surgery Service, Georges-Pompidou European Hospital (HEGP), Department Orthopedic Surgery Center Georges Pompidou European Hospital 20 rue Leblanc 75015 Paris, France, Tel: (+33)6 33 86 17 02

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Abstract

Background: Strength and mobility evaluation through isokinetic testing is popular for knee readaptation, but this type of parameter is not sufficiently studied for elbow recovery. However, functional usual elbow scores mostly attach importance to pain and subjective answers. Including a new objective parameter could help for global elbow evaluation after surgery or elbow traumatism.

Objectives: The purpose of this study was to assess isokinetic elbow evaluation on patients with radial head prosthesis, after severe radial head fracture and elbow traumatism, and compare results with standard functional and clinical evaluation.

Methods: Eighteen volunteer patients with radial head prosthesis at a mean follow-up of 73,3 months were evaluated clinically and functionally by a first examinator (pain, MEPI-score, quick-DASH score and elbow ranges-of-motion). A second examinator performed a blinded isokinetic evaluation. Results were gathered for analysis. Complete and detailed protocol for isokinetic elbow evaluation is presented for extensor and flexor torque.

Results: A 42% of patients kept pain for heavy work or climatic changes. MEPI mean score was 85,2 and quick-DASH score was 22,9%. All ranges of motion were reduced compared to uninjured side. For isokinetic testing, extensor and flexor torque were respectively of 49,2Nm and 40,3Nm at slow motion, and 47,6Nm and 46,7Nm for fast motion. All those parameters were also reduced compared to uninjured side. Statistical analysis didn't find any correlation between functional scores and isokinetic testing.

Conclusion: This study confirms that isokinetic elbow evaluation is feasible, with detailed protocol. This parameter brings new data for evaluation since no correlation is found with standard functional scores. This new and objective tool should be more developed for global elbow evaluation. After sever elbow traumatisms, results of isokinetic evaluation could here explain why patients keep discomfort for heavy work or sporting activities.

INTRODUCTION

Communitive radial head fractures occur in complex elbow traumatisms [1], and need radial head prosthesis when associated injuries compromise elbow stability and internal fixation isn't suitable [2-4]. These situations remain rare, with 15 to 20% of all radial head fractures needing surgical management (fixation, resection or prosthesis [5,1]).

It is known that such global and serious elbow fractures often give sequelae, such as stiffness, residual pain, arthritis, heterotopic ossification, with sometime social consequences for patients.

In radial head prosthesis evaluation [6-13] clinical most used criteria are: pain, Mayo-Elbow Performans Index (MEPI) score, Disabilities of Arm, Shoulder and Hand DASH functional scores, and measurement of Range-Of-Motion (ROM). Yet, pain and functional scores are mostly subjective answers[2], and may not be reproductible according to patients or physicians. A new and objective element could be useful to assess global elbow kinematics and functional use after serious elbow traumatism.

Isokinetic elbow testing consists in strength and mobility evaluation of flexor and extensor muscles around the elbow. This type of testing is mainly used in knee surgery after cruciate ligamentous repair, in order to follow muscular and functional rehabilitation. Applying this technique for elbow could, then, help to assess objective global elbow function. However, this evaluation remains underused, with very few studies including this element in radial head prosthesis results [14].

The purpose of this study was to assess the feasibility and

interest of isokinetic evaluation, compared to standard clinical evaluation in patients who underwent radial head prosthesis after radial head fracture.

METHODS

Patients and study design

This is a retrospective study concerning patients who underwent radial head replacement after fracture in European Georges Pompidou Hospital, Paris, since 2008. We included patients for whom indication for prosthesis was an acute and irreparable comminuted radial head fracture, isolated or with associated injuries (ligamentous injuries, proximal ulna fracture or Essex-Lopresti injury). Exclusion criteria were patients under 18 years-old, time less than 2 years from the prosthesis surgery, important stiffness with arc of motion less than 90°, and medical impossibility to perform straining exercises (ex: heart diseases).

Patients were clinically evaluated with a first investigator in EGP Hospital, Orthopedic department and, if volunteered, were sent to a second blinded investigator for isokinetic testing in Neuro and Orthopedic Rehabilitation Department of Rothschild Hospital. Results were then gathered for comparison.

As it is a retrospective study, investigations were conducted in accordance with the 1964 Declaration of Helsinki ethical standards and with the MR-003 reference methodology in French legislation [15]. The study was registered in the French *Commission Nationale de l'Informatique et des Libertés* (CNIL) database (No. 2222190) and each patient was individually informed and consented before any data collection.

Clinical standard evaluation

The first investigator in EGP Hospital, conducted standard clinical evaluation: quality of pain, MEPI [16] and quick-DASH [17] functional scores, and range-of-motion measurement compared to uninjured side. Patient profile (sex, dominant arm, job, daily activities) and fracture type were also recorded.

Isokinetic testing

The second, blinded and independent investigator in Rothschild Hospital conducted the isokinetic evaluation.

Set-up: Patients were installed on Con-trex PM1 machine (version Mk2k from 2007 ; CMV AG Dübendorf, Swiss). The reference position was: 90° elbow flexion with 10° shoulder abduction and neutral rotation, and forearm in supination. Chest, shoulder and forearm were held with belts, and supination was kept with help of a handle. The dynamometer was lined up with elbow flexion and extension axis. Arc of motion was 120° for flexion and 0° for extension. If the patient had extension loss, the set-up for extension was the maximal possible. The resting reference position was elbow extension.

Testing: Articular warm-up was performed with flexion and extension moves, without then with the isokinetic dynamometer, with 10 repetitions for each side and with maximum speed of 180°/s. The purpose of this warm-up was to introduce isokinetic muscle contraction.

Uninjured side was tested before uninjured side. Two attempts were made for each side. Five repetitions of isokinetic contraction in concentric mode for both extensor then flexor muscles were performed, in slow mode (60°/s) then fast mode (180°/s). Twenty seconds of rest were respected between each repetition. The best result in all attempts and repetition was recorded. Three parameters were recorded: mean maximal torque (in Newton meter), strength (in Watt) and fatigue (in Joule/second).

Patients were supported during the exercise, to ensure the maximal strength possible. Patients were blinded from their performance appearing on the screen during the testing.

Statistical analysis

For each standard clinical or isokinetic evaluation, comparison between injured and uninjured side was performed with paired t-Student test. Correlation between clinical and isokinetic evaluation was made with Spearman correlation test for qualitative data (MEPI score category), and Pearson correlation test for quantitative data (quick-DASH result).

Statistic evaluation was conducted with free software biostatgv.sentiweb.fr.

RESULTS

Patient characteristics

In total, 18 patients with 19 prosthesis could be evaluated. One patient had bilateral implants: only the most recent one was used for analysis, in comparison with the oldest one which had better results. Thirteen were females and 5 males. Mean age at the time of fracture was 50,8 years old (sd 11,5). For 8 patients, dominant arm was involved in the trauma. Three of them were retired, one had a physical job, and the others had sedentary work. All but 3 used to practice sportive activity before the elbow traumatism. Concerning radial head fracture patterns: 2 had isolated communitive radial head fracture, 11 had ligamentous injury in a terrible-triad-like pattern, 4 had proximal ulna fracture (Monteggia-like lesion), and 1 had instability of radio-ulnar distal joint (Essex-Lopresti injury). All were operated on with implantation of the Evolutive radial head prosthesis, a short and cemented stem with bipolar cup, along with repair of concomitant lesions.

Mean follow-up between the surgery and the evaluation was 73,3 months (29 to 133), and 11 patients with more than 5 years follow-up.

Clinical evaluation

Results for pain description, MEPI scores and ROM measurements are presented in following [Tables 1-3]. For quick-

DASH score: mean quick-DASH score was 22,9% (sd 16,2%) and contralateral side 2,3% (sd 3,9%) with significant difference between both sides (p= 0,000041).

Isokinetic testing

Results for torque, strength and fatigue are successively presented in Tables 4-6. For all parameters, control side seems to have better results than injured side, with significant difference only for extensor couple (slow and fast motion), and extensor fatigue in slow motion.

Comparison between clinical and isokinetic evaluation

For this analysis, only the most significant result of isokinetic testing was taken in account, which is the extensor torque in slow motion result. The analysis was also repeated by evaluating correlation using extensor torque slow motion difference between injured and control side. Details of analysis are presented in Table 7.

No correlation was found between all parameters of clinical evaluation and isokinetic results. For example, one patient had an excellent MEPI score but with 57% of extensor torque compared to control side, or some other had a fair MEPI score a with 99% extensor torque.

DISCUSSION

This study confirms feasibility of isokinetic evaluation in elbow, with protocol details. Also, by comparing with standard clinical evaluation, this shows a great heterogenicity between muscle strength recovery among patients, and for different radial head fracture patterns. No correlation was found between isokinetic evaluation and usual functional scores (MEPI and quick-DASH).

Isokinetic evaluation is an objective tool to assess muscle strength recovery and is already mainly used for follow-up rehabilitation after ACL repair in knees. For elbow, few studies exist. One study presents elbow isokinetic evaluation with similar protocol than the one presented here, but the purpose was only to observe differences between dominant and non-dominant arm [18].

Functional scores actually give a great part to pain and patient subjectivity. In MEPI score, pain values 45% of the final score [16]. In quick-DASH [17], the entire limb is evaluated with great subjectivity about difficulties to do some daily activities. Although these tools are useful to follow one patient through time, differences of perception can disturb global evaluation after a fracture or a surgical strategy. Similar comparison between functional scores and isokinetic testing has been made for shoulder after Latarjet technique for 20 patients [19]. After surgery, authors didn't found correlation between strength recovery in external or internal rotation and functional scores (Rowe and Walch-Duplay scores). This result was similar at 6 and 21 months follow-up.

Regarding radial head prosthesis, isokinetic evaluation is rarely presented. In a Canadian study [14], an isokinetic evaluation was made for 55 patients after radial head prosthesis, after a mean 8 years follow-up. Althougth the speed protocol isn't presented, similar results than our study are found with elbow flexion at 35Nm and extension 32Nm (in our study, 38Nm and 42Nm for slow motion). In their study, difference between flexion and extension comparing injured and control side was significant, while in our study it was only significant for extension, maybe due to a lack of power and smaller effective. Also, authors didn't find differences during longitudinal follow-up, and conclude that the muscular recovery is, then, durable.

Another meta-analysis [20] found 5 studies with isokinetic evaluation after radial head prosthesis. Authors showed a loss of strength compared to uninjured side of 14% extension and 13% flexion. Similar observations are also made in the present study, with loss of extension of 17% or 15% and flexion of 24 or 9%, in slow or speed motion respectively. This durable and objective loss of strength could also explain why patients keep discomfort when practicing sportive activities or heavy work, and, thus, can have sequelae after complex elbow traumatism.

CONCLUSION

As a conclusion, isokinetic evaluation for elbow should be part of global functional elbow evaluation since it brings new and objective information along with other clinical parameters (pain, functional scores, ROM). For radial head arthroplasty after communitive radial head fractures, isokinetic evaluation showed that the strength loss is only significant for extensor muscles with a mean 73,3 months of follow-up.

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