

ALPHANUMERIC CODIFICATION IN TRAUMATIC LESIONS OF THE FOREARM

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REZUMAT

Introducere: Traumatismele antebrăului sunt frecvente, datorită implicării membrului superior în diferite activități productive, recreative și ale vieții zilnice. Atât severitatea leziunilor, cât și calitatea diagnosticului și tratamentul aplicat, influențează semnificativ funcționalitatea mâinii, respectiv capacitatea pacientului de reintegrare socio-profesională. **Scopul studiului:** Stabilirea unui sistem de codificare a leziunilor traumatiche ale antebrăului, care să permită identificarea acestora, aprecierea severității lor și deci și a prognosticului funcțional, precum și prelucrarea statistică a datelor cu ajutorul sistemelor informatice. **Material și metode:** Am analizat datele obținute în urma studiului retrospectiv al informațiilor din fișele de observație a 22 de pacienți cu traumatisme de antebră internate în Clinică în primele 3 luni ale anului 2007, coroborate cu datele din literatura de specialitate. Validitatea acestui sistem de codificare am analizat-o în urma aplicării sale pe un lot de 42 de pacienți consecutivi care s-au prezentat în serviciul de urgență al Clinicii pentru traumatisme la acest nivel. **Rezultate și discuții:** Am propus o codificare alfa-numerică a leziunilor traumatiche ale antebrăului, indicând localizarea și morfologia leziunii. Se analizează comparativ și alte scoruri existente. **Concluzii:** Sistemul de codificare propus este un instrument de lucru relativ ușor de aplicat și care oferă informații cuprinzătoare. Pe baza sa se pot face primele estimări cu privire la managementul corect și eficient al cazurilor. De asemenea, servește și ca punct de plecare în elaborarea unui scor de severitate lezională, dar și pentru transmiterea și prelucrarea informatizată a datelor.

Cuvinte cheie: traumatism, antebră, diagnostic, codificare alfa-numerică, prognostic

ABSTRACT

Introduction: Due to the involvement of the upper limb in different productive, recreational and of daily living activities, there is a high frequency of forearm trauma. Both lesions severities, and the quality of diagnostics and treatment, have a significant influence upon hand function and the patient's ability for reintegration into social and professional life. **Aim of the study:** To establish a codification system of forearm traumatic lesions. This can provide both an accurate identification of the lesions and their severity (with impact upon functional prognosis), and also a better statistical interpretation by help of informatic systems. **Material and methods:** Retrospective analysis of data obtained from the files of 22 successive patients with forearm complex trauma admitted in our clinic in the first three months of year 2007; international medical literature review. We performed validation of this research tool by applying it upon 42 consecutive emergency patients who addressed our clinic for traumatic injuries at this level. **Results and discussions:** We propose an alpha-numeric codification of forearm traumatic lesions, indicating wound location and morphology. Comparison is made with other scoring systems. **Conclusions:** The proposed encoding system is a useful working instrument that provides significant amount of information about the lesions. Based on this system, one can make initial estimations regarding the correct and efficient management of each case. It also is a starting point in developing a severity score, as well as in data transmission, gathering and statistic electronic interpretation.

Key Words: trauma, forearm, diagnostic, alpha-numeric codification, prognostic

INTRODUCTION

Forearm traumatic lesions are frequent. Their consequences upon hand function, respectively upon the capacity of patient's social and professional reintegration are significant.¹

Either isolated or in context of a polytrauma injury, having different degrees of severity, these lesions have to be correctly evaluated and treated in order to obtain an adequate morphological and functional result. The management of the case implies patient and wound examination, but also a decision-making process about the therapeutic plan (including the level of care of the medical unit which can provide adequate treatment, necessary material and human resources), and assessment of immediate and late prognosis.²

In our practice we noticed that initial evaluations, sometimes performed by doctors without competence in hand surgery, don't always establish a correct inventory of all lesions, leading to a less favorable patient evolution and a sub-optimal result. That is

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why, both in Romania and at international level, there is a considerable effort in view of a standard approach of these cases, of elaborating protocols, “check-lists” and codifications which allow identification of all diagnostic and contextual elements in view of proper medical care. Thus, patients receive a standard high quality treatment and the medical providers increase their efficiency.

AIM OF THE STUDY

There is little information in the medical literature regarding the specific encoding of traumatic upper limb lesions.^{1,3} The majority of the codification and severity scores published and used analyze the trauma consequences upon: the whole organism, assessing survival, the lower limb to help decide between reconstruction and amputation, isolated anatomical elements.

Therefore, considering the anatomical complexity of the forearm and the interrelations between different elements, but also the consequences of their damage upon the function of the distal segment (the hand), we propose a codification system of traumatic lesions adapted for the forearm. It permits lesions identification, provides the first descriptive information about case complexity and prognostic, represents the base for elaborating a severity score (lesion quantification), allows the synthetic transmission of a significant volume of information and electronic data processing.

MATERIAL AND METHODS

Twenty-two patients with complex forearm trauma were admitted in our Plastic Surgery Clinic in the first three months of the year 2007; they represented the initial study lot for elaboration of the encoding system.

We have started from the basic idea that before you can make a correct appreciation of the severity of a traumatic lesion (indicated by a severity score), the identification and synthetic description (codification) is necessary. This is done preoperatively, based on the clinical and radiological examination, serving as a starting point. The codification is verified/completed intraoperatively. Correlations and lesion associations with impact upon treatment and prognosis are to be identified.

We retrospectively analyzed the information from the admission files, including pictures (pre- and intraoperative), in order to precisely identify wound location and morphology and to evaluate their

influence upon case treatment and prognosis.

Also, we researched medical literature to identify which categories of lesions are considered to be important in describing lesion severity.

Validation of this research tool was done by applying it upon 42 consecutive emergency patients who addressed our clinic for traumatic injuries at this level. Codification was applied by the resident on call, and then discussed with the surgical team, whose members were able, upon this basis, to obtain significant preliminary information and to take informed decisions about patient's triage, surgical planning and prepare of the operative settings.

Discussions were also carried with the main author, in order to evaluate the ease-of-application, the usefulness of this codification and other relevant information. Information thus obtained was introduced in a small data-base, to verify if it allows statistical analysis using research filters. Minor modifications were made in the initial phase of the study to adjust to these remarks.

RESULTS

We have elaborated an alpha-numeric encoding system of traumatic forearm lesions, indicating wound location, injured anatomical elements, and the morphology of the lesion.

Location of the lesion is codified with two ciphers separated by a point and marks the lesion in longitudinal axis as well as in forearm circumference.

a. First number refers to the affected segment of the forearm:

- 1 - proximal third of forearm;
- 2 - middle third of forearm;
- 3 - distal third of forearm.

b. Second number describes the affected quadrant:

- 1 - anterior aspect;
- 2 - radial bord;
- 3 - posterior aspect;
- 4 - ulnar bord.

Example: 1.1 = lesion in the proximal 1/3 of forearm, on the anterior aspect.

If a lesion affects to 2 or more regions, corresponding cipher will be replaced by a group of ciphers separated by a hyphen.

Example: 2.2-3 = lesion in middle 1/3 of forearm, on lateral and posterior aspect, 1-2.3 = lesion in middle and proximal 1/3 of forearm, posterior aspect.

The anatomic elements involved are codified in alphabets. The categories are the following:

NV – neuro-vascular lesion;

OA – osseo-articular lesion; for more than one lesion, the most severe one is codified;

MT – musculo-tendinous lesion;

P/T – tegument lesion, with 2 subcategories, PI (integument closed) and PD (integument open).

Morphology of lesion is codified also with ciphers, from 1 to 5, in increasing severity. For bone lesions we adapted Muller's classification, while for soft tissues we adapted the AO/ASIF classification.

Grouping the last two categories, we obtain the following codification scheme:

NV1 – no lesion;

NV2 – single nerve lesion;

NV3 – single vascular (arterial) lesion;

NV4 – multiple nerve lesions; multiple vessel lesions; combined neurovascular lesions'

NV5 – incomplete/complete amputation;

OA1 – no lesion;

OA2 – simple extraarticular fracture;

OA3 – partial articular fracture, with preservation of some articular surface attached to diaphysis; elbow or radio-carpal simple luxation;

OA4 – complete articular fracture; multifragmentary fracture of diaphysis; complex luxation (irreducible/unstable);

OA5 – articular multifragmentary fracture; bone defect; incomplete/complete amputation.

MT1 – no lesion;

MT2 – localized muscle or tendon sectioning (only one muscle group or tendon);

MT3 – extended musculo-tendinous lesions (two or more muscle groups, more than one TE or TF);

MT4 – avulsion or loss of all muscle groups, dilacerations of TE, TF;

MT5 – compartment or crush syndrome; massive musculo-tendinous dilacerations; defect in TE or TF.

PI1 – no lesion;

PI2 – localized contusion;

PI3 – abrasion, circumscribed degloving;

PI4 – extensive degloving;

PI5 – whole thickness necrosis.

PD1 – no lesion;

PD2 – lesion < 5 cm;

PD3 – lesion > 5 cm; circumscribed degloving;

PD4 – skin defect < 100 cm²; skin with uncertain viability ;

PD5 – extensive degloving; non viable skin; skin defect > 100cm².

At the beginning of codification, to evaluate which forearm is affected, we use letters L (left) and R (right), and * for the dominant limb.

Finally, the alphanumeric codification of a diagnosis is presented in Table 1.

Examples:

L*2.1-2 NV4 OA1 MT3 PD3 = complex trauma of middle 1/3 anterior and radial surface of left dominant forearm, with partial section of median nerve, section of radial artery and its committant veins, muscle mass (brachioradialis, flexor carpi radialis, flexor pollicis longus, superficial flexors for fingers II and III, deep flexor for finger II);

L1-2.3 NV1 OA1 MT2 PD4 = complex lesion of proximal and middle 1/3 posterior surface of left forearm with skin decollation with distally placed pedicle and section of common extensors of fingers at musculo-tendinous junction;

L2.4 NV1 OA2 MT1 PI2 = contusion injury middle 1/3 of left forearm with closed undisplaced fracture of radial diaphysis;

R*3.1-2-3-4 NV5 OA5 = complete amputation of right dominant forearm in inferior 1/3.

DISCUSSION

Trauma is a major public health problem.⁴ Elaboration of scoring systems to quantify lesions severity is several decades old.⁵⁻⁷ An attempt to diminish the frequency and consequences of these lesions requires new instruments and research methods.⁸

Table 1. Alphanumeric codification of diagnosis.

Diagnostic code						
Location		Morphology				
Forearm	Third	Quadrant	Neuro-vascular	Osseo-articular	Musculo-tendinous	Tegument
L, R, *	1, 2, 3	1, 2, 3, 4	NV1-5	OA1-5	MT1-5	P(I, D)1-5

Most of these scores regard severe polytrauma patients, focusing upon survival rate estimation. Some of them have gained a wide area of use, such as Injury Severity Score (ISS), Revised Trauma Score (RTS), Trauma and Injury Severity Score (TRISS), or New Injury Severity Score (NISS), but still, none of them is accepted as golden standard.⁹⁻¹⁴ Recently, attempts have been made to develop a new severity score, International classification of diseases, ninth-revision based (ICISS), used in survival prediction, hospitalisation length, costs.^{15,16}

The variety and multiple combinations of body injuries require more effort to identify specific correlations between lesion location/severity and its consequences upon the organism. Scores were proposed to help in decision-making process of reconstruction/amputation at limb level, but they addressed especially to the lower limb. Some of the most used are: Mangled Extremity Severity Score (MESS), Limb Salvage Index (LSI), Nerve Injury, Ischemia, Soft-Tissue Injury, Skeletal Injury, Shock and Age (NISSSA).¹⁷⁻¹⁹ They are trying to identify factors with impact upon prognostic, such as bone fracture, vasculo-nervous conditions, ischemia (especially worm ischemia time), soft tissue defects. Some of the most comprehensive scores and analysis were designed by orthopedic surgeons, focussing mainly on bone lesions, either isolated or as multiple injuries of the locomotor system.^{20,21}

As trauma research progressed, there appeared new, specific scores to evaluate upper limb injuries, at hand level (Hand Injury Severity Scoring System, HISS), or hand and forearm level (Modified Hand Injury Severity Scoring System, Modified HISS).^{1,3}

The main roles of such scoring systems are the ability to predict outcome (expressed in terms of sensitivity and specificity), the quality management of trauma cases (both in terms of initial evaluation, operative treatment and postoperative results), identification of audit filters, and statistic purposes.^{5,22,23}

These aforementioned severity scores intend to achieve the remarkable end-point of summarizing and integrating a patient's multivariable condition into a one-dimensional value.²² Apart clinical and research use, they also have forensic implications.²⁴

Hand and forearm trauma have specific determination on activities of daily living, return to work and social reintegration.²⁵ In our opinion, considering the specific particularities of hand trauma and their implications from medical and socio-professional point of view upon Romanian target population, it is necessary first to establish achievable goals regarding

data-gathering and transmission, finding a common language between several categories of professionals involved in this specific field and referring the case to the optimal level of care unit in order to improve the morpho-functional result by maximal use of available resources. That's why we considered that it is necessary at first to implement a more descriptive clinical and research tool, namely the alpha-numeric codification. The specific purpose of the codification is to identify and shortly evaluate in terms of severity all the complexity of lesions of a forearm trauma, considering the numerous anatomical structures involved and the potential major impact upon hand function (distal motor and sensitive unit).²⁶

The codification has to be completed based on a thorough clinical examination, completed by X-ray. This often has to be done by medical professionals other than hand surgeons, that's why it has to be both accurate and user-friendly. Evaluation of all potentially harmed elements is done by help of the literal categories (NV – neuro-vascular status, OA – osseo-articular, MT – musculo-tendinous, P – tegument). The neuro-vascular examination was placed first, in order to emphasize their role and also because vascular lesions could determine the degree of urgency to treat.

The cipher 1 was allocated to “no lesion”, in order to determine a systematic approach of clinical examination, without omission of any component. The lesion severity was noted from 1 to 5, in a simple and easy-to-remember scale of gravity, adapting the Muller classification of bone fractures and the AO/ASIF classification of soft tissue damage.²⁷

Wound location in proximal/distal and also circumferential areas helps the examining physician to determine what anatomic elements could have been affected by trauma and actively search for their integrity/lesion.

In general in literature we found two main types of scores and several types of classifications. The first category of trauma scores are simple, easy-to-estimate, mainly based on the physiologic response of the trauma victim, regarding mainly general signs and symptoms (heart and respiratory rate, blood pressure, level of consciousness, and so on). The second category is more sophisticated, based on anatomic findings and injury severity, used for outcome evaluation; this kind of instrument is usually applied once the diagnostic and therapeutic process has been finished.²² In our opinion, the alpha-numeric codification is also a preliminary tool, to be completed by the first health professional that examines the patient, either in a remote rural area or in a busy emergency room of a

university hospital. After the preliminary clinical and radiological examination, the resulting encoding allows basic informed judgments to assess the level of the treating facility, the preoperative planning (including necessary material and human resources) and the grossly estimated prognostic.

After treatment completion, the codification can be refined with intraoperative findings and significant surgical procedures, allowing data gathering and statistic interpretation, elaboration of multi-variable analysis, in order to obtain a valid global score with medical and socio-economical significance.

CONCLUSIONS

The proposed codification is a useful working tool, both for research and clinical purposes. It is easy to use and provides, in a synthetic manner, a significant quantity of information. It also serves as a “check list” for a systematic examination of the traumatized forearm in emergency settings. This descriptive approach of the lesion can lead to the development of a scoring system, classifying trauma severity and its further consequences upon case prognosis, time off-work, medical care and socio-economic costs.

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