



The value of modified DASH questionnaire for evaluation of elbow function after supracondylar fractures in children

Značaj modifikovanog DASH upitnika u proceni funkcijskog stanja lakta nakon suprakondilnih fraktura humerusa kod dece

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Abstract

Background/Aim. The Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Questionnaire represents a region-specific instrument for functional outcome measurement of hand function. The aim of the study was to analyse the correlation between the values of modified DASH questionnaire and change of elbow function after supracondylar fracture (SCF) of humerus and to analyse the effects of early rehabilitation. **Methods.** The study included 35 schoolaged children with flexion of SCF of humerus without lesion of nerves. The patients were divided into two groups: group A in which rehabilitation started up to 14 days after the removal of fixation (20 children), and group B in which rehabilitation started after 15 days and more (15 children). The effects of the applied rehabilitation procedures were analyzed by measuring the range of motion of elbow and using modified DASH questionnaire. Testing was performed during the first examination, on the first day of rehabilitation (retest) and after the rehabilitation. Pearson's coefficient of liner correlation was applied. **Results.** Statistically significant negative correlation of DASH score and extension was verified in all three measurements. The values for the first test and for the final test were highly significant ($p < 0.001$), as well as negative correlation of DASH score and flexion on the first test and retest ($p < 0.01$), and at the end of rehabilitation ($p < 0.001$) in the group B. For all three tests in the group A negative correlation without significant differences for DASH score and flexion was found. **Conclusion.** A modified DASH questionnaire correlates with objective parameters of final status of elbow after SCF in children and it is applicable to small series of patients. A positive effect of early rehabilitation of children with SCF was found.

Key words: questionnaires; elbow; recovering of function; humeral fractures; child; adolescent; evaluation studies.

Apstrakt

Uvod/Cilj. *The Disabilities of the Arm, Shoulder and Hand Outcome Questionnaire* (DASH) je upitnik za procenu nesposobnosti ruke, ramena i šake i pokazuje visok stepen korelacije sa objektivnim pokazateljima funkcijskog stanja ruke. Cilj rada bio je da ispita korelaciju vrednosti modifikovanog DASH upitnika sa poremećajem funkcije lakta nakon suprakondilne frakture (SCF) humerusa kod dece školskog uzrasta i da ispita efekte rane rehabilitacije. **Metode.** Istraživanjem je bilo obuhvaćeno 35 dece školskog uzrasta, uključenih u rehabilitaciju, nakon fleksione SCF humerusa bez lezije nerava. Ispitanici su bili podeljeni u dve grupe: grupu A i grupu B. Grupa A je obuhvatala 20 dece kod koje je program rehabilitacije započet u prvih 14 dana od skidanja imobilizacije, a grupa B 15 dece kod koje je program rehabilitacije započet nakon 15. dana od skidanja imobilizacije. Efekti sprovedene rehabilitacije procenjeni su praćenjem i analizom obima pokreta u zglobu lakta i testiranjem modifikovanim DASH upitnikom. Testiranje je vršeno na prvom pregledu, prvog dana rehabilitacije (retest) i po završenoj rehabilitaciji. Pri utvrđivanju korelacija korišćen je Pearsonov koeficijent linearne korelacije (r). **Rezultati.** Postojala je negativna statistički značajna korelacija DASH skora i ekstenzije, kroz sva tri testiranja u obe grupe, pri čemu je na prvom testu i testu na kraju rehabilitacije ona bila visoko statistički značajna ($p < 0,001$), kao i negativna statistički značajna korelacija DASH skora i fleksije na prvom testu i retestu ($p < 0,01$) i testu na kraju rehabilitacije ($p < 0,001$) u grupi B. U grupi A kroz sva tri testiranja postojala je negativna korelacija bez statističke značajnosti DASH skora i fleksije. **Zaključak.** Modifikovani DASH upitnik je u korelaciji sa objektivnim pokazateljima funkcijskog stanja lakatnog zgloba nakon SCF humerusa kod dece školskog uzrasta i primenljiv je na malom uzorku dece. Značajan je u praćenju efekata i izboru metoda rehabilitacije.

Ključne reči: upitnici; lakat; funkcija, povratak; humerus, prelomi; deca; adolescent; procena, istraživanja.

Introduction

Standardized questionnaires for evaluation of effects of therapy and quality of life have been using in clinical practice for about 50 years¹. The most frequent generic instrument used for life quality analysis in musculoskeletal diseases is the Short Form 36 (SF-36)², and its short version (SF-12)³. However, they can not detect small, region specific changes. This led to development of questionnaires specific for some diseases of articulations⁴⁻⁶. Mayo Elbow Performance Index⁷⁻¹⁰, Ewald Scoring System¹¹, Prichard Score⁷, and Jupiter Score¹² are mainly applied. All of them are valid for small samples. On the other side, they include different combinations of measurements with difficult interpretation of results and poorly correlate to patient's perception. As the consequence, tests for evaluation of the results of therapy of particular region of the body were introduced^{13, 14}.

The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire shows high correlation to objective indicators in patients with elbow diseases¹⁵. The DASH consists of three scales. The first one evaluates total function of upper extremity (symptom/function score). It includes 30 parameters for measurement of daily activity, routine and ability to participate in daily life and social activities during previous week, and measures reduced activity by pain¹⁶. The DASH includes two other scales concerning ability to perform sport and/or to play musical instrument (sport/music scale), and ability to work (work scale) that does not necessarily affect daily life. Each question has five answers, starting from no symptoms to inability to perform activity with advanced symptoms. Total score is obtained by summing data, and ranges from 0 (no disability) to 100 (total disability). Test is not valid if answers to more than 10% of questions are not obtained. One to two week test-retest interval is advised for better reliability, while others use questionnaire in two successive days^{13, 17}. In this respect, the DASH would be suitable because of its property of being mainly a measure of disability. In addition to decreasing the administrative burden associated with using different disease-specific measures, one of the main concepts behind developing the DASH was to facilitate comparisons among different upper-extremity conditions in terms of health burden. The DASH is now available in several languages, and studies of reliability and validity have been published for the original version as well as for the German, Italian, Spanish and Swedish versions. In addition, research studies regarding a French and a Dutch version of the DASH have been published¹⁷. As similar questionnaire that could be applied in children has not been created, some modifications of DASH had to be done. Supracondylar fracture (SCF) of humerus is extraarticular and characteristic for childhood. Extensive study on 5228 such fractures indicated its incidence to amount 79.8%¹⁸. Orthopedic treatment consists of immobilization for fracture without dislocation, reposition, Kirschner needle and vertical skeletal extension for dislocation, and secondary surgical reposition and fixation for complicated cases. The purpose of rehabilitation of SCF is to restore elbow function and to prevent complications. Many therapeutical modalities are used: therapeutical exercise,

cold (ice therapy), occupational therapy and electrotherapy. The aim of this study was to correlate functional changes after supracondylar fracture of humerus in children with modified DASH (m-DASH) questionnaire and to analyze the results of early physical therapy.

Methods

This prospective controlled and opened clinical study, included 35 schoolaged children with rehabilitation after flexion of SCF of humerus without nerve lesion, was conducted. For 20 children rehabilitation started 1-14 days after removal of immobilization (group A), and for 15 children rehabilitation begun 15 or more days after removal of cast (group B). The groups were formed randomly. Inclusion criteria were: age 7-16 years, SCF of humerus Gartland I, II and III, no associated fractures on the same extremity, all questions answered on all procedures performed, and minimum one day interval between the removal of cast and examination. Exclusion criteria were: nerve lesion and other bone/articular or neurological disease.

Both groups were treated using therapeutical exercise, occupational, hydro- and electrotherapy. Criomassage of elbow joint lasted for 5 minutes and was initial procedure. Therapeutical exercise and occupational therapy included active and actively supported movements, as well as progressive resistance for 30 minutes in order to improve muscular strength. Hydrotherapy was applied in a pool with water temperature of 35 °C for 30 minutes. An average length of rehabilitation amounted 18.23±7.13 days for the group A, and 24.15±6.01 for the group B.

Testing protocol included: initials, age, days from the cast removal to examination, and days from the cast removal to initiation of rehabilitation. Range of motions in elbow was estimated in degrees using goniometer. Flexion is defined as angle between flexed forearm and imaginary line during maximally extended undamaged forearm. Restricted full extension had negative mark. A modified DASH questionnaire was used by the same examiner during the first visit, on the day rehabilitation begun (retest), and at the end of rehabilitation.

Modification of DASH was performed in order to make it appropriate to children age. It consisted of 10 questions answered by child or parent. Five grade scale was used for the first three questions, while three grade scale was adopted for the rest of questions. This was based on the fact that it is difficult for the child to differentiate between grades. All questions were related to the period after removal of immobilization (Table 1).

Descriptive statistical measures, as well as Student's *t* test and Pearson's coefficient of linear correlation were used. Values for $p < 0.05$ were considered statistically significant, an values for $p < 0.01$ were highly significant.

Results

The age of patients ranged from 7 to 14 years, without significant difference between the groups. Rehabilitation

Table 1
Modified the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire (m-DASH)

No of question	Question	Difficulty				Unable
		no	mild	moderate	severe	
1.	Arm, shoulder or hand pain	1	2	3	4	5
2.	Arm, shoulder or hand pain when you perform any specific activity	1	2	3	4	5
3.	Stiffness in your arm, shoulder or hand	1	2	3	4	5
4.	Write	1		3		5
5.	Place an object on a shelf above your head	1		3		5
6.	Wash your back	1		3		5
7.	Wash or blow dry your hair	1		3		5
8.	Carry a heavy object	1		3		5
9.	Turn a key	1		3		5
10.	Manage transportation needs (getting from one place to another)	1		3		5

Individualized standardized score is calculated according to equation:

$$\text{Individualized standardized score} = \frac{(\text{Summed value of scale items}^* - \text{Minimum score}^\dagger)}{\text{Score range} [\text{Maximum score}^\ddagger - \text{Minimum score}^\dagger]} \times 100$$

* Sum of scale values

† Number of scale items multiplied by lowest score value (equals 1)

‡ Number of scale items multiplied by highest scale value (1 or 5)

started on average after 4.5 days in the group A (early rehabilitation), and after 18 days in the group B (late rehabilitation). Test-retest interval was between one and six days in both groups.

Patients in the group B had statistically lower values of all the questions of a m-DASH questionnaire in comparison to the group A. Retest data were also lower in the group B, but significant difference was found for one half of the questions. At the end of rehabilitation procedure, patients in the group A had the same values for five questions, lower for four questions, while elbow pain during specific activities was lower significantly. The obtained values of m-DASH questionnaire are presented in Table 2. During the first test

and retest patients in the group B had lower scores of m-DASH in comparison to the group A ($p < 0.001$). Retest scores were lower in both groups. At the end of the applied rehabilitation children in the group A had lower values of m-DASH, but without statistical significance (Table 3). Flexion of elbow in the group A was on the first test lower, slightly higher on retest, and significantly higher at the end of rehabilitation in comparison to the group B ($p < 0.001$). Increased flexion was found in both groups after rehabilitation procedure (Table 4). Extension of elbow in the first group was significantly worse (negative values) at the first test and retest ($p < 0.05$). At the end of rehabilitation extension in the group A was significantly better than in the group B

Table 2
Values of modified the Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire on first test, retest and after rehabilitation (mean±SD)

Question	First test			Retest			After physical therapy		
	Group A	Group B	<i>p</i>	Group A	Group B	<i>p</i>	Group A	Group B	<i>p</i>
1	1.95±0.76	1.27±0.46	< 0.01	1.70±0.73	1.13±0.35	< 0.01	1.00±0.00	1.00±0.00	
2	2.40±0.50	2.00±0.38	< 0.05	2.10±0.31	1.93±0.46		1.05±0.22	1.33±0.49	< 0.05
3	1.25±0.44	1.00±0.00	< 0.05	1.20±0.41	1.00±0.00		1.00±0.00	1.00±0.00	
4	3.20±1.58	2.20±1.01	< 0.05	3.00±1.59	2.20±1.01		1.10±0.45	1.00±0.00	
5	2.90±1.02	1.67±0.98	< 0.01	2.70±0.73	1.67±0.98	< 0.01	1.00±0.00	1.13±0.52	
6	4.10±1.02	3.40±0.83	< 0.05	3.90±1.02	3.40±0.83		1.10±0.45	1.53±0.92	
7	3.30±0.98	2.47±1.41	< 0.05	2.90±0.45	2.47±1.41		1.10±0.45	1.40±0.83	
8	4.70±0.73	3.40±1.35	< 0.001	4.70±0.73	3.40±1.35	< 0.001	1.50±0.89	1.80±1.26	
9	3.20±0.89	1.93±1.03	< 0.001	3.10±0.79	1.80±1.01	< 0.001	1.00±0.00	1.00±0.00	
10	1.90±1.02	1.00±0.00	< 0.01	1.70±0.98	1.00±0.00	< 0.01	1.00±0.00	1.00±0.00	

Table 3
Total values of modified the Disabilities of the Arm, Shoulder and Hand (DASH) score at the first test, retest and after rehabilitation (mean±SD)

Test	Group A	Group B	<i>p</i>
First test	47.25±16.02	25.83±13.08	< 0.001
Retest	42.50±13.08	25.00±13.26	< 0.001
After rehabilitation	2.13±4.54	5.50±8.36	

($p < 0.05$), and slightly lower than undamaged elbow. In both groups rehabilitation highly significantly improved extension of elbow (Table 5). Negative correlation between m-DASH score and extension was found in both groups ($p < 0.01$) with the biggest difference on the first test in the group A. Negative correlation between m-DASH and flexion of elbow was verified on the first test and retest in the group B ($p < 0.01$), while it was negative without statistical significance in the group A for both tests. Correlation was similar at the end of physical therapy. Highly significant negative correlation between m-DASH and extension was found in the group A ($p < 0.001$) and in the group B ($p < 0.01$). Negative correlation between m-DASH and flexion of elbow was present in both groups, but it was significant only in the group B ($p < 0.01$) (Table 6, Figure 1).

function and disability. Because of higher responsiveness these tests require a smaller sample size than a generic measures^{13,14}. DASH outcome questionnaire produced high correlation to objective indicators in patients with elbow diseases. It can detect improvement or worsening of health status in most patients. Clinical studies in adults have proven test-retest reliability of DASH scale¹⁵. This test correlates more closely to pain and functional loss than any other elbow score¹³.

Assessment of daily functioning of children may need different tests for functioning and disability. As no application of DASH in children is reported, some modifications were made for such purposes in this study. Firstly, it was shortened, and only age relevant questions were asked. Scoring system was also simplified, according to the ability of children to differentiate various options.

Table 4

Flexion of elbow (in degrees) at the first test, retest and after rehabilitation (mean±SD)

Test	Group A	Group B	<i>p</i>
First test	90.75±30.53	104.33±9.42	
Retest	106.50±7.27	104.33±9.42	
After rehabilitation	139.00±7.54	126.00±11.98	< 0.001

Table 5

Extension of elbow (in degrees) at the first test, retest and after rehabilitation (mean±SD)

Test	Group A	Group B	<i>p</i>
First test	-39.00±16.19	-28.00±8.62	< 0.05
Retest	-32.00±9.92	-25.33±7.90	< 0.05
After rehabilitation	-4.50±6.67	-11.60±13.32	< 0.05

Table 6

Pearson's coefficient of linear correlation (*r*) between modified Disabilities of the Arm Shoulder and Hand Questionnaire (m-DASH) score and flexion (FLEX) and extension (EXT) at the first test, retest and after rehabilitation

Group		First test		Retest		After rehabilitation	
		EXT	FLEX	EXT	FLEX	EXT	FLEX
A (n=20)	<i>r</i>	-0.70	-0.39	-0.60	0.12	-0.85	-0.43
	<i>t</i> test	4.21	1.81	-3.17	0.50	-6.99	-2.05
	<i>p</i>	< 0.001		< 0.01		< 0.001	
B (n=15)	<i>r</i>	-0.72	-0.68	-0.66	-0.69	-0.70	-0.83
	<i>t</i> test	3.75	3.31	-3.14	-3.47	-3.51	-5.46
	<i>p</i>	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.001

Discussion

Different standardized questionnaires for evaluation of effects of therapy and quality of life are used in rehabilitation medicine¹⁻¹⁴. Since upper extremity disorders are associated with considerable health care, reliable and valuable measures are needed. All of them have had some disadvantages, such as inability to detect small region specific changes, or too many combinations of measurement parameters. Region specific tests are introduced in assessment of upper extremity pain,

In this study at the first test and retest flexion of elbow was lower in the group A (early rehabilitation) when compared to the group B (late rehabilitation), but without statistical significance. Rehabilitation procedure led to significantly better improvement of flexion in the group A. The same was valid for extension of elbow.

At the end of rehabilitation of SCF of humerus children from the group A achieved significantly better results indicating better recovery of elbow function in the group with early rehabilitation. Immediately after the removal of immobilization there

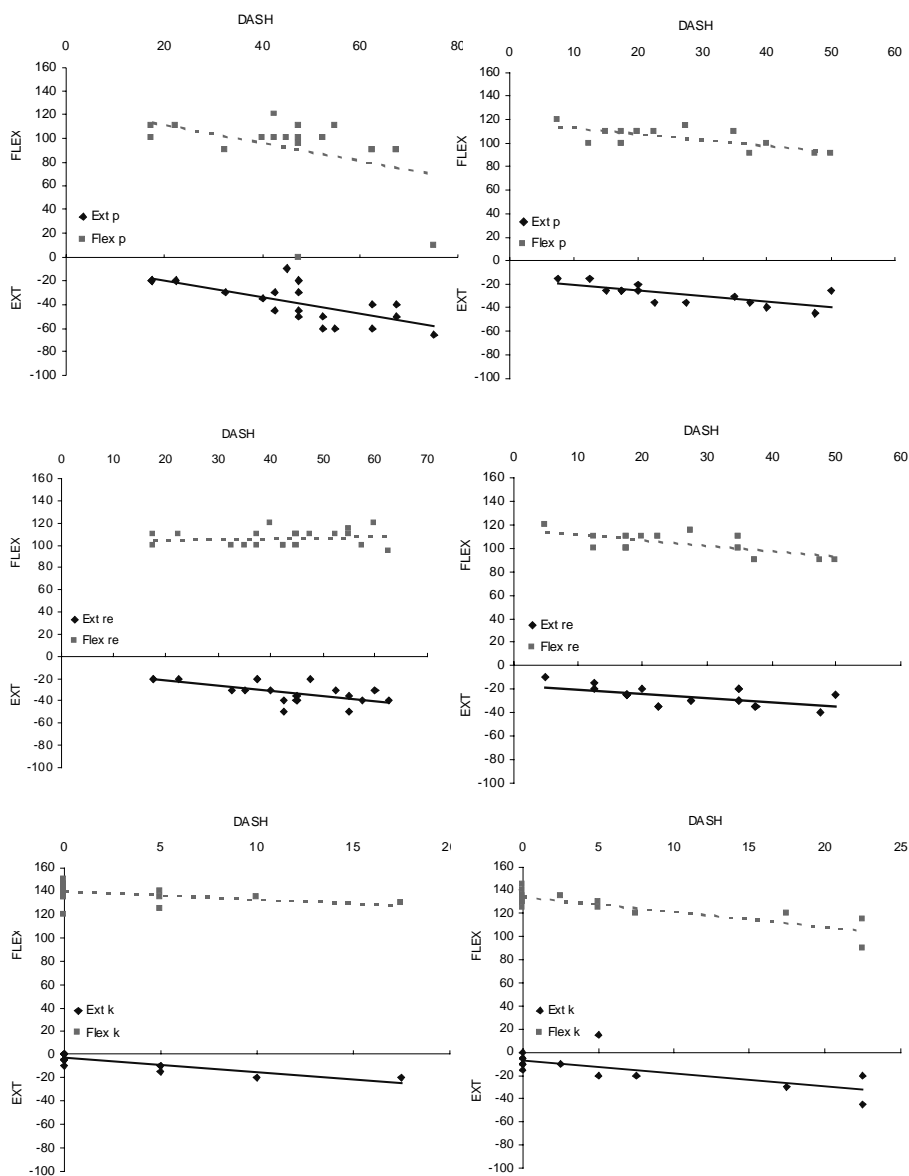


Fig. 1 – Correlation between modified Disabilities of the Arm, Shoulder and Hand (m-DASH) score and flexion (FLEX) and extension (EXT) at the first test (upper row), retest (middle row) and after rehabilitation (lower row) for the group A (left) and the group B (right)

was fear during performing active movements, especially in children. Activities adequate to age are needed during evaluation of elbow function, as used in m-DASH questionnaire.

Pearson coefficient of linear correlation confirmed statistically significant negative correlation between m-DASH and extension of elbow in both groups; with a higher value in the group A (higher values of DASH indicate a worse extension). At the end of rehabilitation the correlation was similar.

For flexion function of the elbow negative correlation was present on the first test and retest, with highly significant values in the group B, and non significant values in the group A. The absence of significance in the group A can be explained by high sensitivity of children to pain immediately after removal of immobilization.

These data imply that values of m-DASH questionnaire in all three measurements correlate with objective indicators of elbow function after rehabilitation of SCF of humerus in children.

Conclusion

A m-DASH outcome questionnaire is valuable in estimation of physical therapy, and clinical evaluation of SCF of humerus in children. It should be used complementary to other questionnaires. Early rehabilitation of SCF in children results in significantly better elbow function, and it should start within 15 days after removal of immobilization.

R E F E R E N C E S

1. *Guyatt GH, Feeny DH, Patrick DL.* Measuring health-related quality of life. *Ann Intern Med* 1993; 118(8): 622–9.
2. *Ware JE Jr, Sherbourne CD.* The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992; 30(6): 473–83.
3. *Ware J Jr, Kosinski M, Keller SD.* A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996; 34(3): 220–33.
4. *Atrosbi I, Gummesson C, Johnsson R, Sprinborn A.* Symptoms, disability, and quality of life in patients with carpal tunnel syndrome. *J Hand Surg [Am]* 1999; 24(2): 398–404.
5. *Davis AM, Beaton DE, Hudak P, Amadio P, Bombardier C, Cole D, et al.* Measuring disability of the upper extremity: a rationale supporting the use of a regional outcome measure. *J Hand Ther* 1999; 12(4): 269–74.
6. *Swiontkowski MF, Buckwalter JA, Keller RB, Haralson R.* The outcomes movement in orthopaedic surgery: where we are and where we should go. *J Bone Joint Surg Am* 1999; 81(5): 732–40.
7. *Morrey BF.* Functional evaluation of the elbow. In: *Morrey BF*, editor. *The elbow and its disorders*. 2nd ed. Philadelphia: W.B. Saunders; 1993. p. 86–97.
8. *Cobb TK, Morrey BF.* Total elbow arthroplasty as primary treatment for distal humeral fractures in elderly patients. *J Bone Joint Surg Am* 1997; 79(6): 826–32.
9. *King GJ, Adams RA, Morrey BF.* Total elbow arthroplasty: revision with use of a non-custom semiconstrained prosthesis. *J Bone Joint Surg Am* 1997; 79(3): 394–400.
10. *Ring D, Adey L, Zurakowski D, Jupiter JB.* Elbow capsulectomy for posttraumatic elbow stiffness. *J Hand Surg [Am]* 2006; 31(8): 1264–71.
11. *Schemitsch EH, Ewald FC, Thornhill TS.* Results of total elbow arthroplasty after excision of the radial head and synovectomy in patients who had rheumatoid arthritis. *J Bone Joint Surg Am* 1996; 78(10): 1541–7.
12. *Holdsworth BJ, Mossad MM.* Fractures of the adult distal humerus. Elbow function after internal fixation. *J Bone Joint Surg Br* 1990; 72(3): 362–5.
13. *Turbin DC, Beaton DE, Richards RR.* Validity of observer-based aggregate scoring systems as descriptors of elbow pain, function, and disability. *J Bone Joint Surg Am* 1998; 80(2): 154–62.
14. *Hudak PL, Amadio PC, Bombardier C.* Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. *The Upper Extremity Collaborative Group (UECG) Am J Ind Med* 1996; 29(6): 602–8.
15. *Sathyamoorthy P, Kemp GJ, Rawal A, Rayner V, Frostick SP.* Development and validation of an elbow score. *Rheumatology (Oxford)* 2004; 43(11): 1434–40.
16. *McConnel S, Beaton DE, Bombardier C.* *The DASH outcome measure user's manual*. 1st ed. Toronto: Institute for Work & Health; 1999.
17. *Gummesson C, Atrosbi I, Ekdahl C.* The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. *BMC Musculoskelet Disord* 2003; 4: 11.
18. *Landin LA.* Fracture patterns in children. Analysis of 8,682 fractures with special reference to incidence, etiology and secular changes in a Swedish urban population 1950-1979. *Acta Orthop Scand Suppl* 1983; 202: 1–109.

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