VILNIUS UNIVERSITY

Šarūnas Mažeika

SOCIAL AND CLINICAL FACTORS OF UPPER EXTREMITY SEGMENTS' REPLANTATION DURING LAST 25 YEARS

Summary of Doctoral Dissertation
Biomedical sciences, Medicine (06B)

Vilnius, 2011

The Doctoral Dissertation was prepared at Vilnius University in 2007–2011.

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The Dissertation will be defended at the public session of the Board of Medical Sciences of the Vilnius University on 2nd of December 2011, 4.00 p.m. in the Grand Hall of Vilnius University Hospital Centro Affiliate.

Address: Žygimantų str. 3, LT-01102 Vilnius, Lithuania.

The summary of the Doctoral Dissertation was sent on 28th of October, 2011.

The Doctoral Dissertation is available at the Library of Vilnius University (Universiteto str. 3, Vilnius, LT-11000, Lithuania).

VILNIAUS UNIVERSITETAS

Šarūnas Mažeika

VIRŠUTINĖS GALŪNĖS SEGMENTŲ REPLANTACIJŲ KLINIKINIAI IR SOCIALINIAI VEIKSNIAI PER PASTARUOSIUS 25 METUS

Daktaro disertacijos santrauka

Biomedicinos mokslai, medicina (06B)

Vilnius 2011

Disertacija rengta 2007–2011 metais Vilniaus universitete

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Disertacija bus ginama viešame Medicinos mokslo krypties tarybos posėdyje 2011 m. gruodžio mėn. 2 d. 16 val. VšĮ VUL Santariškių klinikų Centro filialo Didžioje auditorijoje.

Adresas: Žygimantų g. 3, LT-01102 Vilnius, Lietuva.

Disertacijos santrauka išsiuntinėta 2011 m. spalio mėn. 28 d.

Disertaciją galima peržiūrėti Vilniaus universiteto bibliotekoje (Universiteto g. 3, Vilnius, LT-11000, Lietuva).

ABBREVIATIONS

CI – confidence intervals

FET – Fisher's exact test

JPR – Joinpoint Regression Program

LMWH – Low molecular weight heparin

MS – Microsoft

WHO – World Health Organization

OR – odds ratio

SQL – Structured Query Language

SD – Standard Deviation

VUH – Vilnius University Hospital

INTRODUCTION

The first successful upper extremity replantation was made more than 50 years ago. The first replantation of totally amputated fingers was made more than 30 years ago. During this period microsurgery and replantations have become commonplace in the developed world. Currently the number of scientific publications about replantation decreased and reduced in their content. The majority of publications are case report series and results of individual surgeon or replantation center practice. Only a small part of publications describes previously unexamined trends. Epidemiology of amputations and replantations is poorly investigated, too. The number of successful upper extremity segments' replantations exceeded 2000 in Lithuania. However, these materials are poorly analyzed. There are some unresolved issues in replantology. There is no consensus on definitions used in replantology. Currently, the same terms by different authors are used to define different phenomena. As a result, comparing different sources it is difficult to compare different data.

The most common complications after replantations are thrombosis and spasm of blood vessels. Nowadays 95 per cent of surgeons use at least one of three main antithrombotic medicines (Heparin, Aspirin, Dextran) after replantations and free flap transplantations. However, there is no consensus about the use and effectiveness of medicines in survival of replants or flaps. Evidence-based research studies in effectiveness of medicine are rare and contradictory. The majority of these studies are animal trials. Clinical studies on humans are rare. In recent years, a new approach to the use of medicines after replantation and free flap transplantation has been developing: the use of anticoagulants is overvalued. There are only few prospective and retrospective studies to deny prophylactic use of anticoagulants to increase the survival of replants and flaps.

THE AIM OF THE STUDY

To analyze the upper limb segments' replantations' clinical outcome and social factors, and their dynamics, and to identify and assess the various factors affecting the survival of replants.

OBJECTIVES

1. To determine socio-demographic characteristics of patients after amputation and replantation of upper extremity segments during 1983–2007 years.
2. To determine trends and possible causes of upper extremity segments' replantation during 1983-2007.
3. To evaluate non-medication factors for surveillance of upper extremity segments' replants.
4. To evaluate the significance of prophylactic use of medications for surveillance of upper extremity replants.

DEFENSIVE STATEMENTS

1. The number of upper extremity segments' replantations decreased during the years 1983-2007.
2. Non-medications factors: amputation type and amputation level, and patient's gender, and injury tool play a role for survival of upper extremity replants.
3. The importance of prophylactic use of medications for survival of upper extremity replants is low.

SCIENTIFIC NOVELTY OF THE STUDY

This work for the first time in Lithuania reviewed and analyzed 25 years material of upper extremity replantations in the oldest and largest center replantation center in Lithuania – VUH Centro Affiliate Plastic and Reconstructive Surgery Department. We assessed clinical and social factors and determined their relationship of replantated upper extremity segments. We

determined dependencies between prophylactic use of medications and replants survival ratio during the investigation period. We also analyzed different meanings of replantology terms and offered some guidelines for their proper usage.

LITERATURE REVIEW

A review of literature presents the historical aspects of replantolgy and free flap autotransplantation. In 1902 Carel performed “end-to-end” vascular anastomosis by hand with “3-stay suture technique”. In 1903 Hoepfner first performed limb replantations in dogs. In 1921 Nylen first used an operating microscope during operation. In 1953 Carl-Zeiss Co manufactured a commercially available operating microscope OpMi-1. In 1958 Jacobson and Donaghy founded the first microsurgery training laboratory. Successful replantation and transplantation experiments in dogs were performed in Russia (Lapchinsky et al.), the USA (Snyder et al.) and Japan (Onjy et al.). In 1962 Malt and McKhann performed the first successful arm replantation in human. In 1964 Kleinert and Kasdan performed the first revascularization for incompletely amputated thumb. Komatsu and Tamai successfully replanted a totally amputated thumb. Various free flap autotransplantations were made in the seventies. By the end of the 1970s replantation surgery was widespread thorough the world. Indications for upper extremity replantation started developed according to long-term functional results. “Survival without restoration of function is not success”.

The problem of different use of terms in replantology

Despite the long history of replantology, there is confusion over terminology in replantology. Various authors use different terms when defining the same type of amputation. One can find more than a dozen different terms to describe amputation types. The most common used terms describing type of amputation are “guillotine” and “avulsion”. The first means minimal damage and no tissue defects of an amputated part and stump. The second describes a situation of

massive local and distant damage of bone and tissue. All remaining types of amputation are located without clear limits between guillotine and avulsion types. “Incomplete amputation”, “replantation” and “revascularization” are main terms of definition and the content of discussion. Amputation is called incomplete (partial, subtotal) if the amputated part is connected to stump by tissue bridge. There are discussions about the structure and size of tissue bridge. Classification of amputation by Biemer is common and widespread:

1. **Total amputation**. There must be no remaining connection with the body
2. **Subtotal amputation.** The main vascular connections must be interrupted and there must be no evidence of circulation. Most of the functional structures must be separated and the soft tissue connection should be less than one-quarter of circumference of the part.
3. **Revascularization** defines a condition in which most of functional structures are separated but in which there is evidence of residual circulation which can only be improved by vessel anastomosis.

Unfortunately this classification has raised a lot of discussion. No agreement is achieved till nowadays. Most discussion is as to what kind of injury to call “partial amputation”. Different opinions of various authors can be grouped into three categories:

1. The injury in which the injured part is connected to the body by **soft tissue connection** and there is **no evidence of circulation** in the injured part.
2. The injury in which the injured part is connected to the body by **soft tissue and bone connection** an there is **no evidence of circulation** in the injured part.
3. The injury in which the injured part is connected to the body by **soft tissue connection and there is circulation** in the injured part.

Some authors suggest calling “replantation” the reattachment of total amputation only. They offer to call “revascularization” the reattachment of subtotal amputation. The advantage of using a term “replantation” for total

amputation only gives us understanding about amputation grade (partial or total) from operation entitlement. Division of operations into replantations and revascularizations is significant if the results are different. Results of replantation can be divided into two groups: survival of replants (early results) and restoration of function (late results). The term “revascularization” does not contain any information about the structure of a tissue bridge and the operation type (anastomosis arteries and/or veins). The term “revascularization” is widely used in medicine and means: a) formation of new blood vessels and b) restoration of injured circulation by anastomosis or shunt. Because of the use the confusing term “revascularization” for replantation of subtotal amputation, a new term “neorevascularization” is used for describing the formation of new blood vessels. Some authors use new terms “near total amputation” or “devitalization” to distinguish subtotal amputation with no circulation from injuries with circulation.

During our investigation we selected patients who had total amputation and subtotal amputations with no evidence of circulation in the replanted part.

Indications and contraindications for replantation

In the beginning the goal of replantation was to restore circulation and to survive the amputated part. Nowadays the aim of replantation is a function restoration of the replanted segment. In 1979 Chen formed principals of patient’s choice for replantation:

1. The essential structures of the dismembered part of the severed limb must be intact; in particular, the vascular bed should not have suffered serious damage.
2. The severed limb should have been preserved reasonably well.
3. The time interval between limb severance and reestablishment of blood circulation should not be too long, so that irreversible degeneration of tissue cells has not developed.

4. The replantation operation should be expected to produce a reasonable degree of functional recovery.

Indications and contraindications for replantation are neither absolute nor static. Increasing experience modifies them. The most common indications for replantation in the literature are: amputations in children, many finger amputations, major segments amputation, amputation of the thumb, finger distal superficial tendon attachment amputation.

Contraindications for replantation can be grouped under three categories:

1. Severe amputations in which a chance of survival or function restoration is very low.
2. Replantation is not possible because of serious patient's general condition or additional extensive injuries.
3. Patient disagrees for replantation or does not collaborate with medical staff.

Recently some contraindications for upper extremity replantation are reviewed according to long-term results. Commonly found contraindications for replantation are long warm ischemia of the amputated part, freezing of the amputated part, one-finger amputation in 2nd flexor tendon's zone (this contraindication is now disputed), extensive tissue crushing or avulsion, injuries on many levels of amputated parts, severe co-morbidities (additional traumas, chronic peripheral vascular and circulatory disorders, generalized atherosclerosis, a serious autoimmune disease, etc.) major psychiatric disorders, serious contamination or crushing of the amputated part, and poor segment function before amputation because of previous injuries.

Prophylactic use of medications to improve survival or replanted part

The most common complications after replantation are thrombosis of an anastomosis and vasospasm. These complications are more frequent in the first days after a replantation. Many medications and their combinations, and procedures are prophylactically used to avoid these complications. These medicines are: aspirin, heparin, LMWH, prostacyclin, normovolemic

hemodilution (and dextran), regional anesthesia, nonsteroidal anti-inflammatory drugs, sedative, tissue plasminogen activator, urokinase. Lidocaine and papaverine are used to topically reduce vasospasm during operation. Less used and further investigated medicaments are nitric oxide, hirudin, modulators of fibrinolysis, platelet receptors antagonists. Anticoagulant efficacy trials can be divided into several groups:

1. Animal trials, in which small arteries are prepared, cut and anastomosed. Patency of vessel and/or development of thrombosis and/or surveillance of animal are observed.
2. Animal trials in which small arteries are prepared, cut, intimenctomy performed and sutured. Radiolabelled 32^{P} platelets accumulation and/or thrombus formation, and/or blood vessel patency are measured.
3. Restrospective studies or prospective trials in human. The aim is to assess whether the use of medications was significant for the survival of amputated part when compared with groups who did not receive this medication or received other medications.

The majority of trials are performed on animals. The results are controversial. The same tests performed on different animals or under different types of anesthesia show different results. Despite this, nowadays 95 % of microsurgeons use at least one of three main anticoagulant (aspirin, heparin, dextran) after the replantation or free flap transplantation. In recent years, survival rate after replantation depending on the type of amputation exceeds 70 to 95 %. Survival of free flap transplantation exceeds more than 95 %. Recently, discussions about general prophylactic use of anticoagulant arise if general prophylactic use of anticoagulant overweighs systemic and local anticoagulants' complications.

Because of a lack of research on humans, which can prove the benefit of prophylactic medication use for replantations survival ratio, we decided to evaluate dependencies between prophylactically used medications and replants survival ratio in our study.

MATERIALS AND METHODS

This study is retrospective. The object of research is 1983–2007 years VUH Santariskių Klinikos Centro Affiliate Plastic and Reconstructive surgery department patient's patient histories. Selection criteria's are:

a) There is total or subtotal upper extremity segment amputation and there is no evidence of circulation in amputated part and the bone is damaged;
b) Replantation was performed and circulation was restored, regardless of whether the replanted segment survived or not.

Injures with intact bone and joint or with evidence of circulation in injured segment were excluded.

Approximately half of 1983's patient histories were destroyed by the statute of limitations. Seven medical histories were lost. 1573 patient histories satisfied the selection criteria and were accepted for the study. We collected data with MS Access and analyzed with MS Access, MS Excell, SPSS, Mintab, JMP and JPR programs. The level of statistical significance was set to $p<0.05$. In all cases, the actual value of the level of significance was given using up to three decimal numbers. If case when p value was lower than 0.001, we were indicating it with "$p<0.001$".

We conducted three research areas in data analysis:

1. Descriptive analysis and socio-demographic data analysis. For numerical variables we computed the mean, median, mode, standard deviation, sample range and so on. We categorized the "Age" variable into five-year interval groups and into five broad population groups, based on WHO recommendations. Pearson Chi-Square (χ^2) and Fisher's Exact tests were used to compare groups among themselves. Assessing the rank correlation between categorical variables Spearman correlation coefficient was calculated. Assessing the normal distribution variables trend, we calculated linear regression curve. To check whether a variable is distributed according to normal distribution Kolmogorov–Smirnov test was calculated.

2. Calculating trends of variables during the investigation period. Joinpoint program (Hudson method) was used. 1983 years' data were excluded while examining absolute numbers, because the data of 1983 years were incomplete. The data of 1983 years were included in analysis while calculating relative numbers (such as an average patient's age). When calculating the amputation level trends, all the amputation levels were grouped into three categories: fingers, finger blocks and large segments (hands, forearms, upper arms).
3. Determination dependencies between various variables and the survival rate of replanted segment. Person Chi-Square and Fisher's Exact tests were used to determine dependencies between non-medication variables and segment survival rate. Contingency tables for comparing groups who used medications with these who did not use medications, calculating odds ratio (OR) of segment surveillance with 95 % confidence intervals (CI) and binary logistic regression test, comparing survival rate of the replanted segments each year were used to determine dependencies between medicine variables and the segment survival rate.

STUDY RESULTS

General and socio-demographic data of the patients

1573 patients (1942 segments) underwent upper extremity segments replantation from 1983 to 2007. Among these, there were 799 cases of total amputations and 774 cases of subtotal amputations. Both arteries and veins were anastomosed in 1056 patients during replantations. The average age of patients is 32.97 yr.; SD – 17.103; median – 33 yr.; mode – 21 yr. Large patient's age groups based by WHO recommendations are presented in Figure 1. 1323 patients were male and 250 were female (5:1). Male-female ratio was

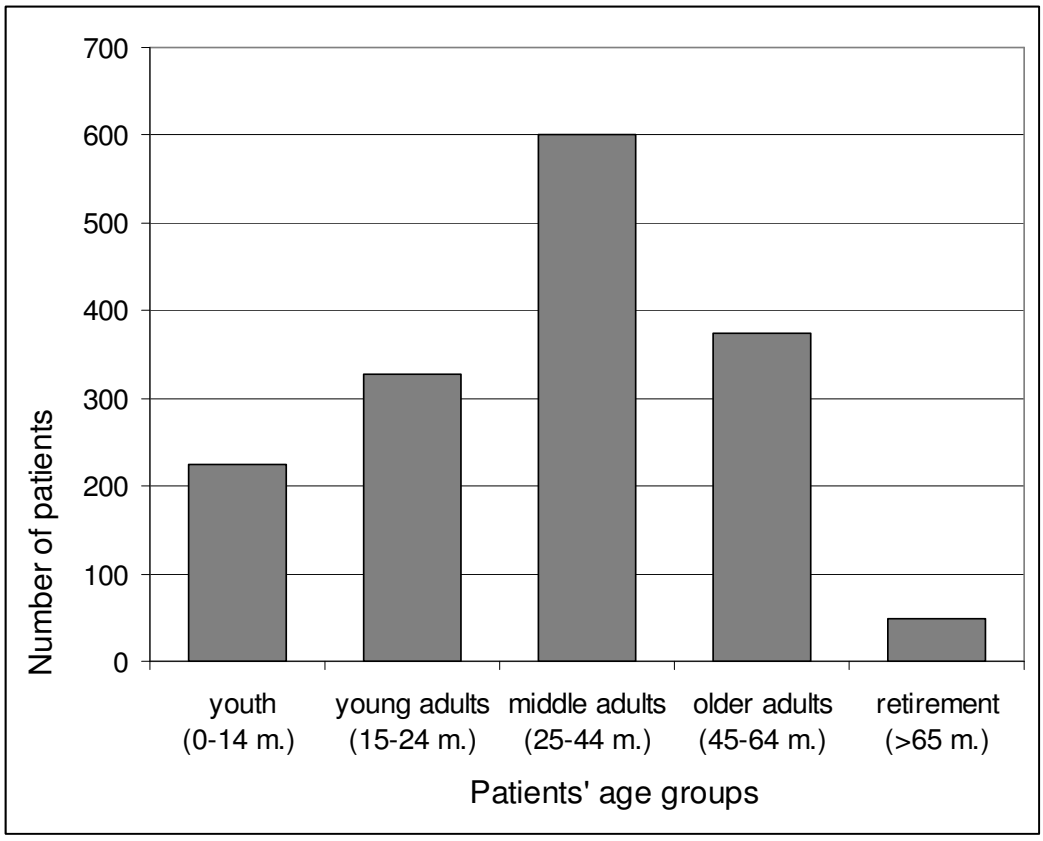

Fig. 1. Patients' age groups, categorized according WHO recommendations

the same when comparing urban and rural groups. Male-female ratio difference ($p<0.001$) in patient age five-years-intervals group is presented in Figure2. 55.88 % of patients were urban and 44.12 % were rural. During 1983–1990, 52 patients from foreign countries were operated. Average hospitalization time was 15.77 days (median – 12, mode – 11, SD – 12.229). Social composition

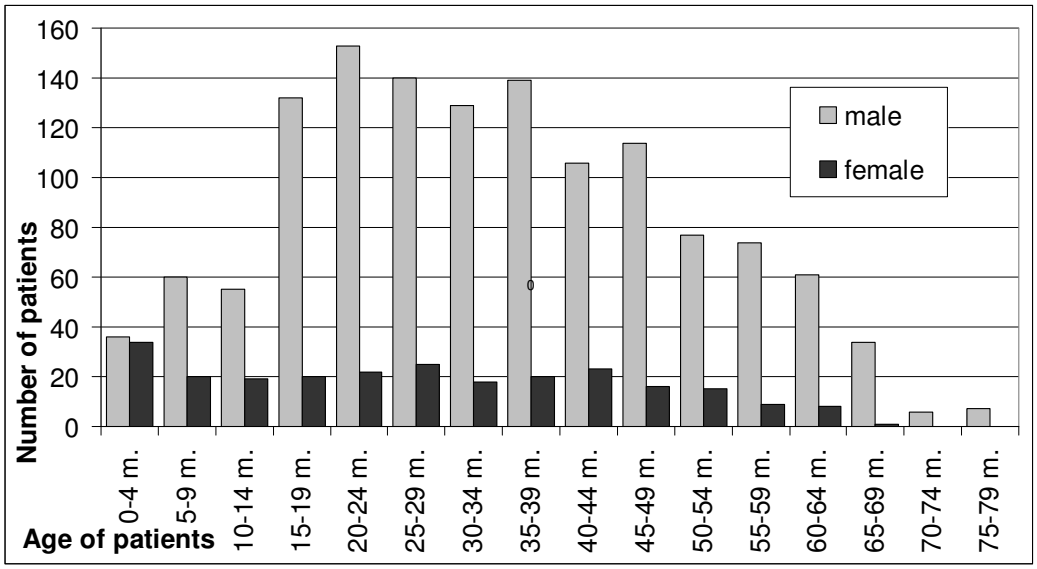

Fig. 2. Male and female five years age groups

included 49.71 % workers, 6.74 % office workers, 10.11 % unemployed, 12.14 % schoolboys; 6.04 % preschoolers, 4.64 % pensioners and 8.89 % other social groups. Left hand was injured more frequently – 54.55 %. Replantations were performed on both hands simultaneously in six cases. Almost half of injures (48.51 %) occurred in conjunction with circular-saw or chainsaw. Cutting tools were 2nd common injuries tools (16.02 %). We found significant ($p<0.001$) difference of distribution injury tools between male and female (Table 1). Main injury tools for male were chain-saw or circular-saw. Female amputated

Table 1. Distribution of injury tools among male and female patients

Patients' sex	Injury tools					
	Circular or chain-saw	Cutting tools	Drill machine	Press	Other machine tools	Other injury tools
Male	723	186	55	21	86	252
	54,65 %	14,06 %	4,16 %	1,59 %	6,5 %	19,05 %
Female	40	66	1	18	19	106
	16 %	26,4 %	0,4 %	7,2 %	7,6 %	42,4 %

upper extremity segment with saws rarely. The most common injuries tools of the largest female "other injury tools" group were food preparation machinery (19 cases), chain (9 cases), bread making machinery (8 cases) and grass cut machine (5 cases). We have found significant ($p<0.001$) difference between

Table 2. Distribution of injury tools among amputations at work and at home

Place of amputation	Injury tools					
	Circular or chain-saw	Cutting tools	Drill machine	Press	Other machine tools	Other injury tools
At work	216	33	45	38	71	159
	38,43 %	5,87 %	8,01 %	6,7 6%	12,63 %	28,29 %
At home	547	219	11	1	34	199
	54,1 %	21,66 %	1,09 %	0,1 %	3,36 %	19,68 %

distribution of injuries tools between injuries occurred at work and injuries occurred at home (Table 2). Amputation's type distribution was "guillotine", crush and avulsion in 10.11 %, 74.57 % and 15.32 % respectively. We have found statistically significant ($p<0.001$) difference in distribution of amputation type among "injury at work" and "injury at home" groups. Avulsion type amputations were twice more common in injuries at work than at home. Proportions of avulsion and guillotine amputation types are higher among females than males. The proportion of crush amputation is higher among males than females ($p<0.001$). We have found a significant difference ($p<0.001$) of distribution of amputation types in injury tools groups (Table 3).

Table 3. Dependencies between amputation tools and amputation types

Injury tools	Amputation type					
	Guillotine		Crush		Avulsion	
	N	%	N	%	N	%
Circular or chain-saw	7	0,92	747	97,90	9	1,18
Cutting tools	125	49,60	123	48,81	4	1,59
Drill macine	0	0	0	0	56	100
Press	1	2,56	34	87,18	4	10,26
Other machine tools	7	6,67	69	65,71	29	27,62
Other injury tools	19	5,31	200	55,87	139	38,83

Amputation levels distributed as 83.85 % fingers, 8.97 % transmetacarpal and midpalm amputated parts; 2.67 % hands and 7.19 % parts amputated above wrist. Table 4 presents distributions of total and subtotal amputations in each

Table 4. Distribution of total and subtotal amputations between various amputation levels

Amputation level	Amputation grade			
	Subtotal		Total	
	N	%	N	%
Finger	546	52,75	489	47,25
Two fingers	78	35,78	140	64,22
Three fingers	13	27,66	34	72,34
Four fingers	8	42,11	11	57,89
Block of two fingers	9	39,13	14	60,87
Block of three fingers	22	44,90	27	55,10
Block of four fingers	19	55,88	15	44,12
Midpalm	22	62,86	13	37,14
Hand	20	47,62	22	52,38
Forearm	27	46,55	31	53,45
Arm	10	76,92	3	23,08

amputation level. The distribution of injury tools in amputation level groups is presented in Table 5. The most common injury tool in every amputation level group is circular-saw and chainsaw. The frequency of cutting tools decreases with more proximal amputation level groups.

Table 5. Distribution of injury tools among levels of amputation

Amputation level	Circular or chain-saw	Cutting tools	Drill machine	Press	Other machine tools	Other injury tools
Fingers	588	241	56	30	84	320
	44,58 %	18,27 %	4,25 %	2,27 %	6,37 %	24,26 %
Block of fingers and midpalm	114	8	0	3	6	10
	80,85 %	5,67 %	0 %	2,13 %	4,26 %	7,09 %
Hand	24	2	0	4	7	5
	57,14 %	4,76 %	0 %	9,52 %	16,67 %	11,90 %
Forearm	36	1	0	2	4	15
	62,07 %	1,72 %	0 %	3,45 %	6,90%	25,86 %
Arm	1	0	0	0	4	8
	7,69 %	0 %	0 %	0 %	30,77 %	61,54 %

During replantation, the restoration of circulation by suturing vessels is essential for survival of an amputated part. Distribution of sutured vessel and suture type is presented in Table 6. Arteries were sutured “end-to-end” in

92.63 % of the cases. 7.12 % cases required vein grafting to overcome an arterial defect. Proportion of vein grafting for arteries increases in more proximal amputation level groups ($p<0.001$). Vein grafting for arterial defects was more common (61.54 %) than "end-to-end" suture in arm replantations. Vein suturing was not necessary in total replantation 32.87 % cases due to adequate blood outflow in soft tissue connection between amputated part and body.

Table 6. Distribution of vessels anastomoses' types during replantation

Type of vein anastomosis	Type of artery anastomosis						Total:	
	Primary suture		Graft interposition		No anastomosis			
	N	%	N	%	N	%	N	%
Primary suture	963	61,22	50	3,18	4	0,25	1017	64,65
Graft interposition	19	1,21	20	1,27	0	0	39	2,48
No anastomosis	475	30,2	42	2,67	0	0	517	32,87
Total	1457	92,63	112	7,12	4	0,25	1573	100

Depending on amputation type, there is a significant difference ($p<0.001$) in increasing frequency of use vein grafts for arterials' and veins' defects with increasing tissue damage. Vein's graft for arterial defect was used in single case (0.63 %) only and vein graft for vein's defect was used in another single case (0.63 %) only in cases of guillotine amputations. Vein's grafts were used in 5.03 % cases and in 1.28 % cases in cases of crush amputations and in 21.58 % and in 9.54 % in for arterial's and vein's defects respectively in cases of avulsion amputations. Ability to suture nerves during replantation depends ($p<0.001$) on tissue damage also (Fig 3.). None of damaged nerves were sutured in 55.6 % cases of avulsion amputations. All damaged nerves were sutured in 88.05 % cases of guillotine amputations. Distribution of "sutured all nerves", "sutured not all nerves" and "nerves not sutured" was very similar among guillotine and crush amputations but significantly differed ($p<0.001$) from avulsion amputations. Proportions of "sutured not all nerves" and "nerves not sutured" were higher in groups of injury tools such as drilling machine (73.21 %), press (38.46 %), other machinery (19.05 %), where the proportion of avulsion amputations was higher (Fig.4).

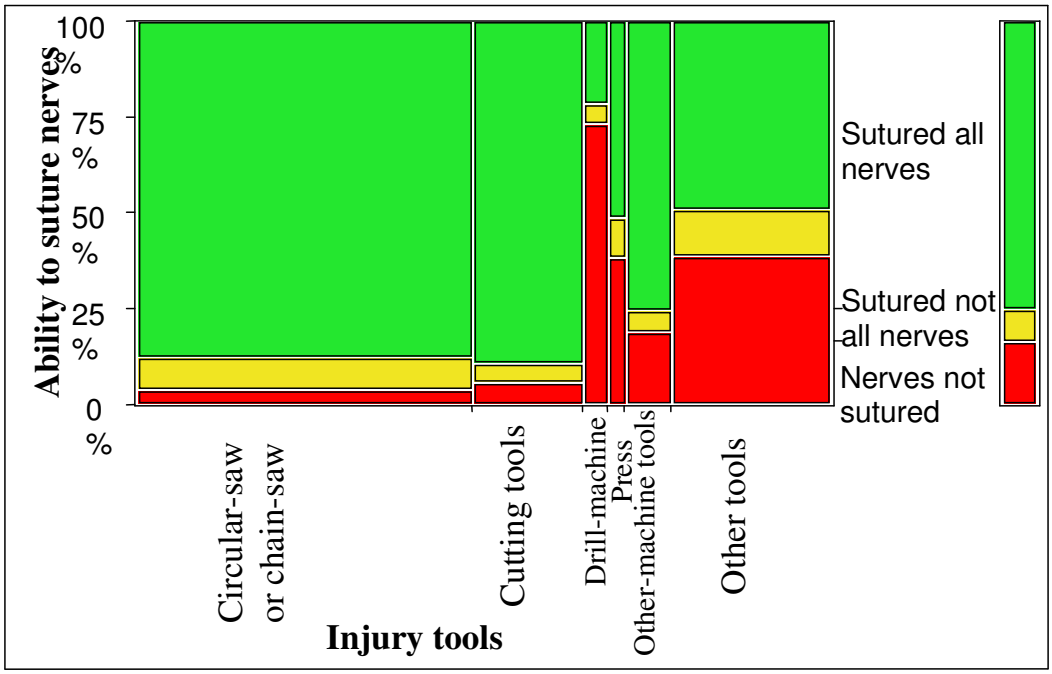

Fig. 4. Distribution of ability to suture nerves between amputations made by various injury tools

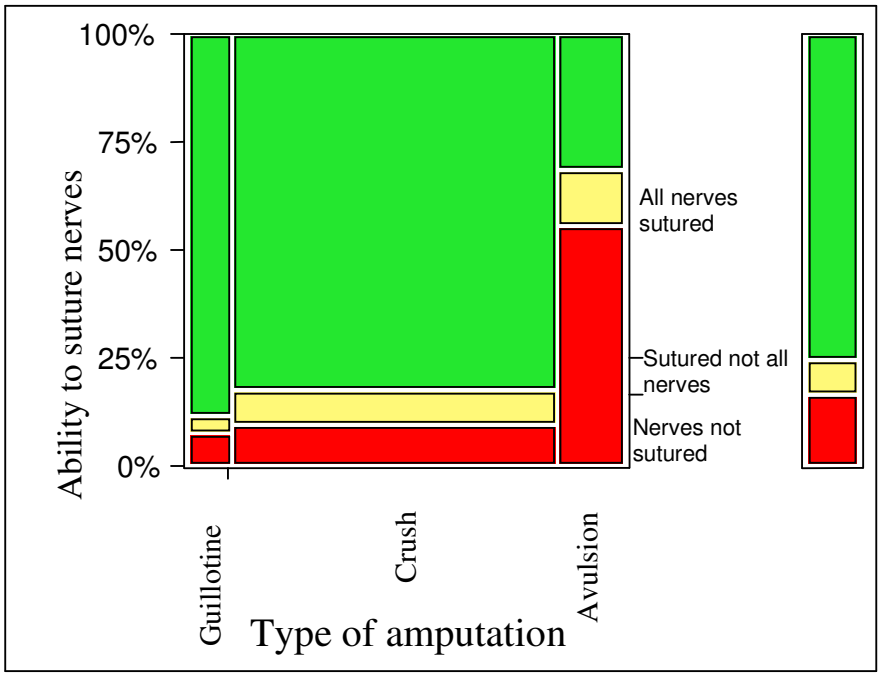

Fig. 3. Distribution of ability to suture nerves between amputation types

Circulation disturbances in replants were documented in 24.16 % cases (Fig. 5 and 6). The majority (31.05 %) of circulation disturbances occurred during the

first 24 hours after replantation. We have found strong negative correlation and linear relationship between postoperative time and the decreasing circulation disturbances rate (Spearman $\rho=1$; $p<0.001$). As postoperative time increases, the rate of complications decreases. We have found the same correlation regardless of blood vessels sutured (artery, vein or both) and amputation type (total or subtotal) – $r^2 \in [0{,}971; 0{,}983]$; $p \in [0{,}008; 0029]$.

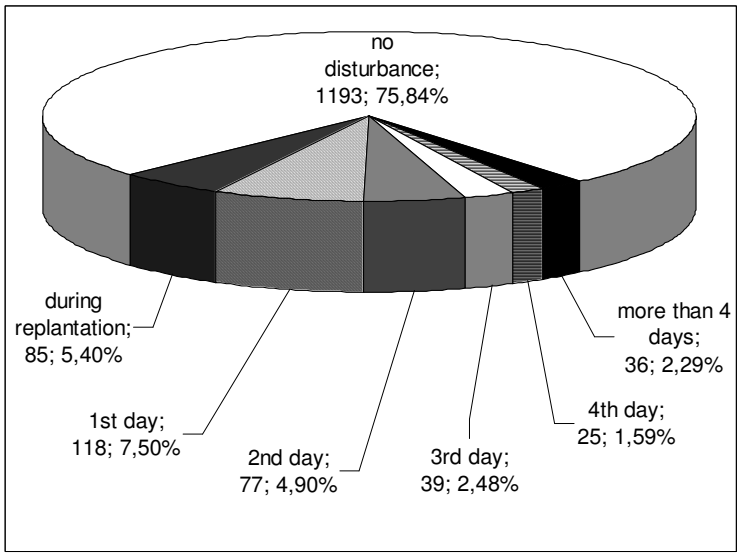

Fig. 5. Circulation disturbances during postoperative period

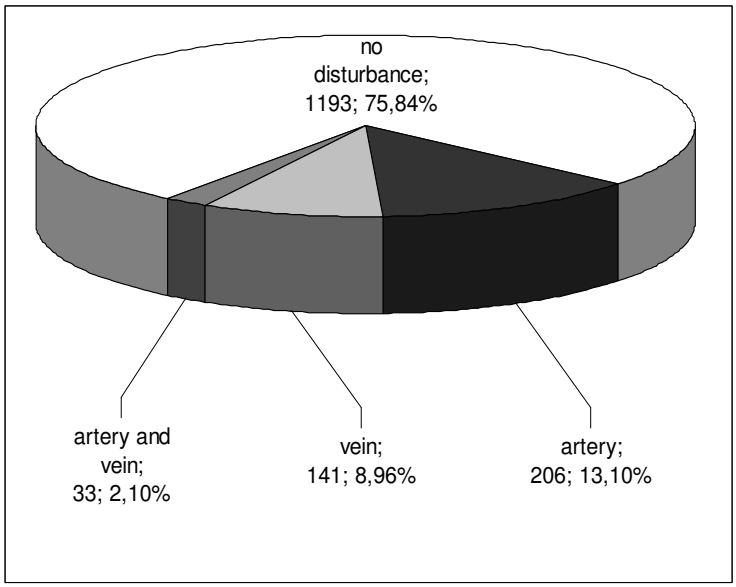

Fig. 6. Type of vessels, in which circulation disturbed

Calculation of trends during the investigation period

The total number of replantations decreased from 115 in 1984. to 29 in 2007. (Average – 3.4 replantation per year; Kolmogorov-Smirnov test p=0.904, linear regression: r^2=0.907; b=3.443; p<0.001) (Fig. 7). The total number of replantations decreased almost by three replantations per year during 1984–1989 (t=–1.712; p=0.118). The decrease was much significant: by nine replantations per year during 1989–1992 (t=1.219; p=0.251). During 1992–1999 the total replantation number did not differ much. During 1999–2002 the total replantation number decreased significantly again by 8.7 replantations per year (t=–1.030; p=0.327). The total replantation number did not change much (29-39 per yr.) since 2000. Changing trends of total and subtotal amputations numbers did not differ much during all observation period (Fig 7).

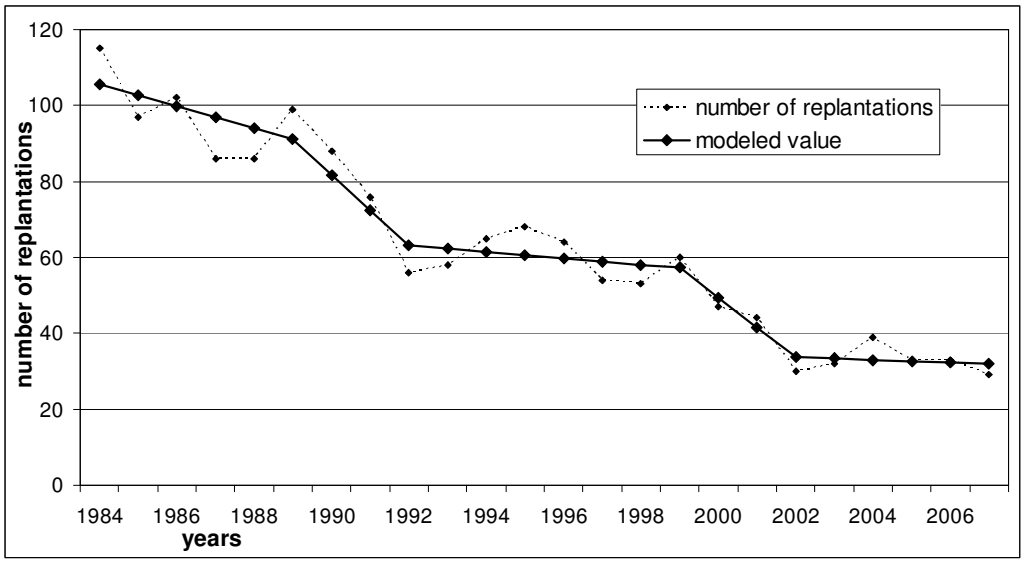

Fig. 7. Trend of changing replantation number

We have found a difference between numbers trends of various amputation levels (Fig 8). There is a significant difference between finger replantation number and the number of more proximal segments' replantation. The finger replantations number did not change (~95) during 1984–1989. The number of finger replantations dramatically decreased by almost ten cases in each year during 1989–1992 (b=–2.081; t=–7.664; p<0.001). A slow decrease of finger replantations' number was observed to the end of investigation period

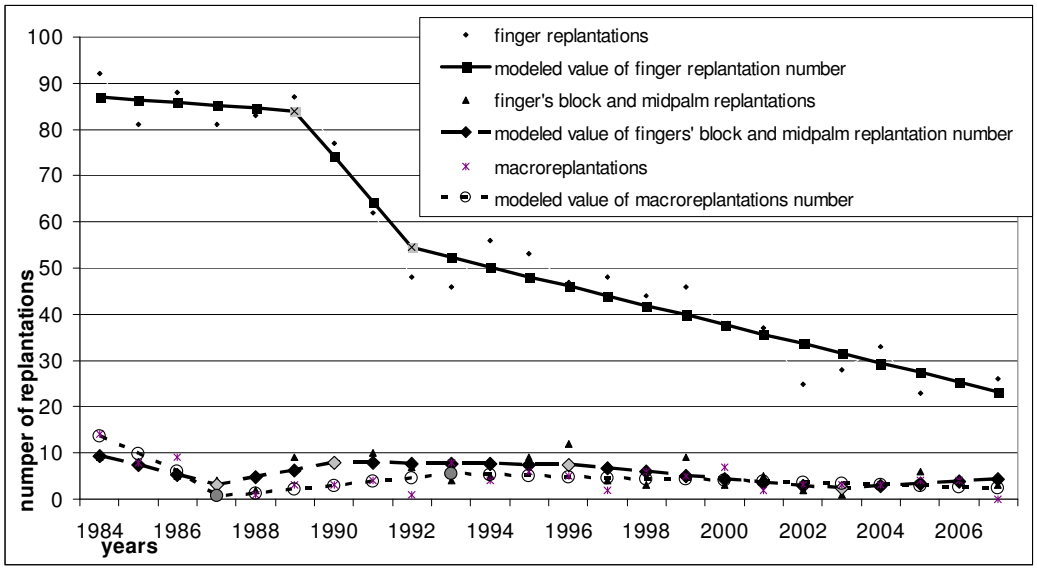

Fig. 8. Trends of changing numbers of various amputation levels replantations

b=-2.081; t=–7.664; p<0.001). The number of replantations of more proximal segments did not change significantly during all the investigation period.

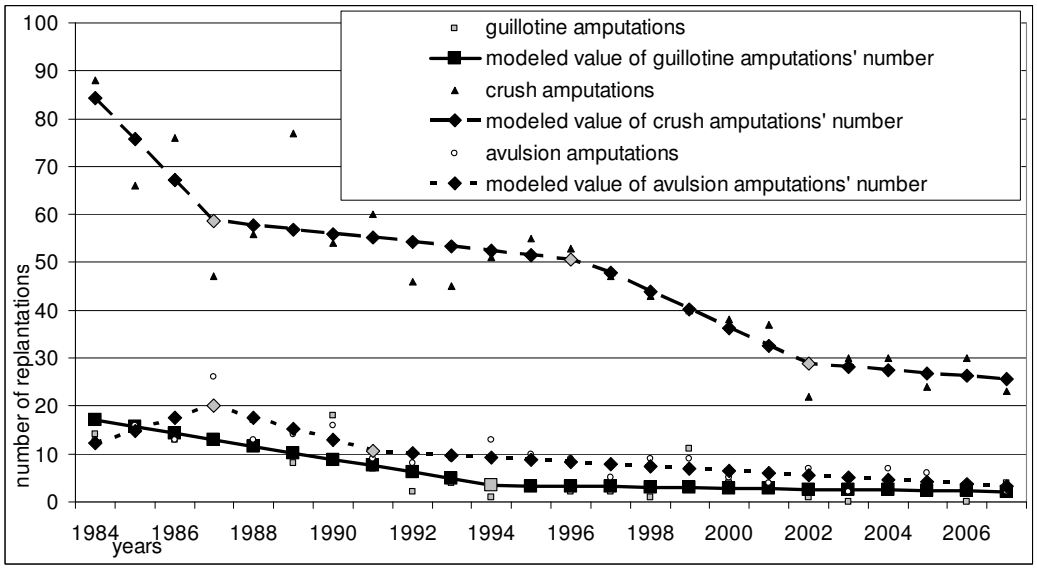

Fig. 9. Trends of changing numbers of various amputation type replantations

The trends of numbers of replantations due to various amputations types differed, too (Fig 9). There was asignificant decrease of crush amputation number by 8.5 replantations per year during 1984–1987 (t=–1.650; p=0.121). In the period of 1987–1996 this number was decreasing slowly by one replantation per year. During 1996 – 2002 the decrease was more prominent

(b=–3.780; t=–1.628; p=0.126). Since 2002 the decrease was very slow again. Replantations due to guillotine and avulsion amputations numbers did not change so significantly during the investigation period.

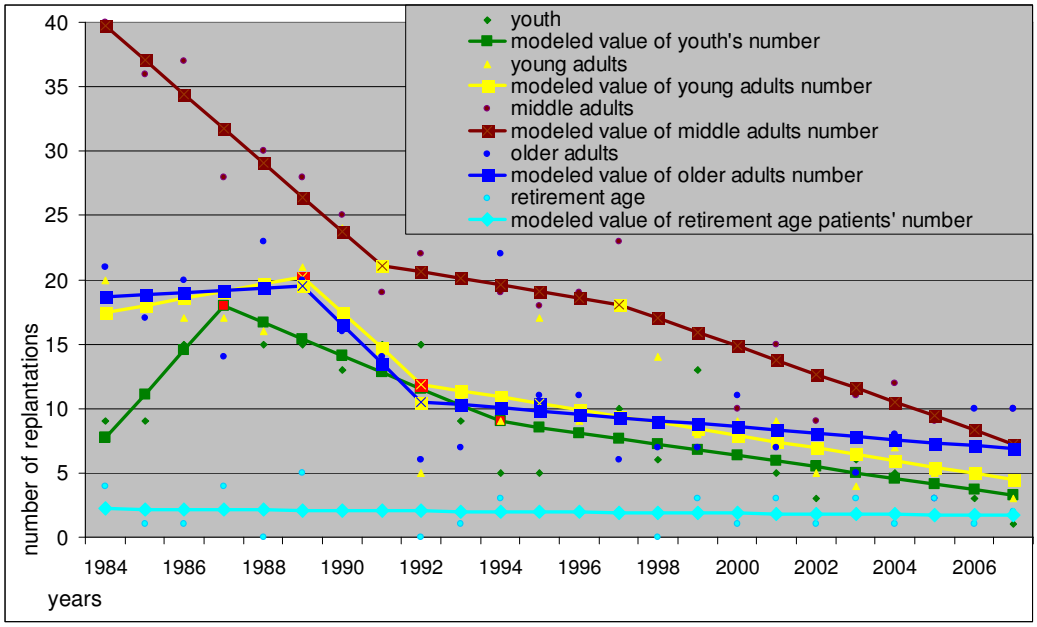

Fig. 10. Trends of changing numbers of various patients ages groups replantations

During the entire investigation period the dominant age group of operated patients was middle adults (25–44 yr.) (Fig. 10). The number of middle adults decreased quickly during 1984–1992 (b=–2.663; t=–6.848; p<0.001), slowly during 1992–1997 and quickly again during 1997–2007 (b=–1.085; t=–4.790; p<0.001). The trends of changing number of young adulthood (15–24 yr.) and older adulthood to retirement age (45–64 yr.) patients groups were similar during investigation period. Curves and joinpoints of these groups are very close to each other. In the beginning of the investigation period there were slight increases in sizes of these groups. During 1989–1992 the sizes of these groups decreased by three patients per year. Since 1992 to the end of investigation period the size decreased slightly. The number of youth patients dramatically increased during 1984–1987 (b=3.410; t=1.945; p=0.069) and after that was decreasing till the end of the investigation period (1987–1994: b=–1.280; t=–2.159; p=0.046 and 1994–2007: b=–0.442; t=–2.403; p=0.029).

Patients of retirement age group were operated rarely (2–5 patients) per year during the investigation period.

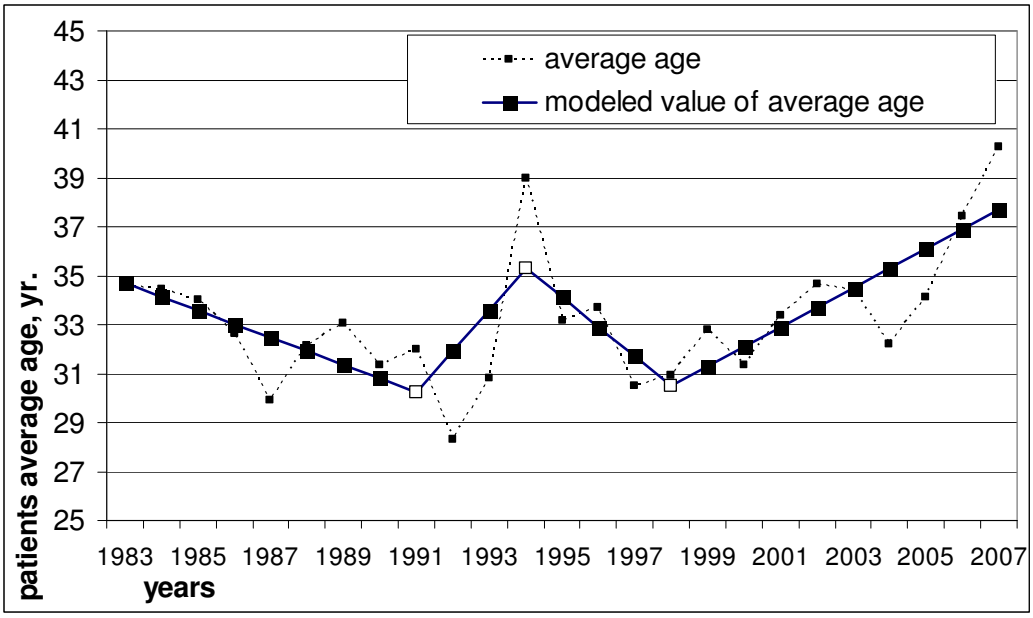

Fig. 11. Trend of changing patients' average age

Modeled values curve of average patient age is similar to the letter "W" (Fig. 11). In the first part of the investigation period (1983–1991) the average patients' age decreased (b=–0.555; t= 3.007; p=0.009). During 1991–1997 there were some fluctuations of average patients' age value. The lowest value of patients' age was 28.29±4.74 yr. in 1992. The highest value was 39±4.15 yr. in 1994. This difference is statistically significant (t=3.576; p<0.001). During 1997–2007 the average patients age increased by almost one year during each observation year (b=0.799; t=3.419; p=0.004).

During 1984–1996 the total number of injuries at home did not change much (Fig. 12). This number was decreasing significantly from 1996 to the end of observation period by 2.8 per year (t=–7.014; p<0.001). The total number of injuries at work decreased slowly by 2.3 per year in 1984–1989 (t=–2.096; p=0.052) and dramatically by 9.5 per year in 1989–1992 (t=1,958; p=0,068). From 1992 to the end of observation period the number of injuries at work did not change much.

Urban and rural patients' numbers' changing trends did not show any sudden changes during observation periods. The numbers' trends of urban and rural

patients decreased slightly (Fig. 13).

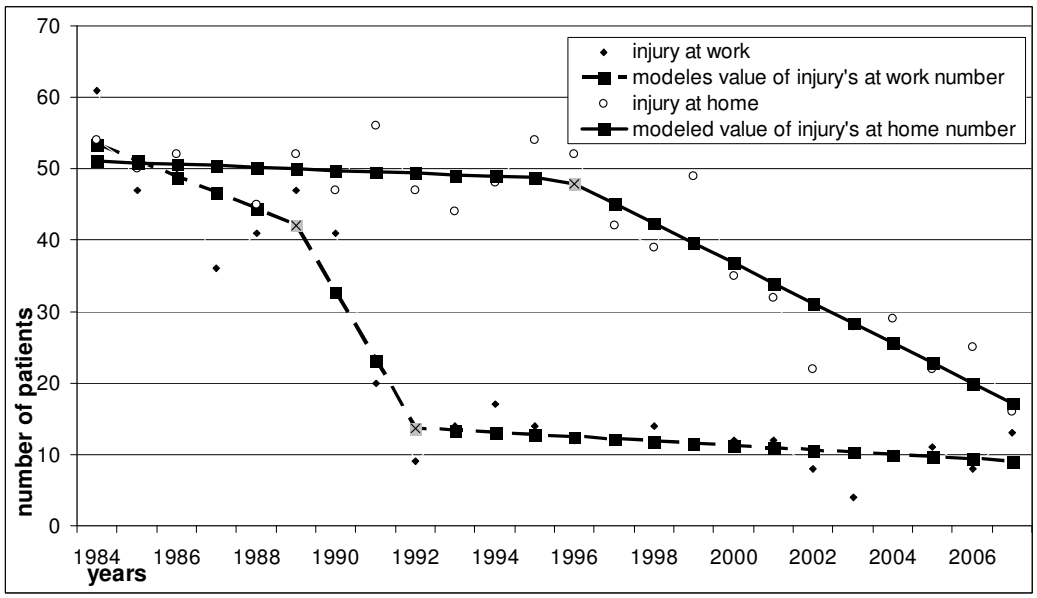

Fig. 12. Trends of changing number of amputation place of patients, to whom replantations were performed

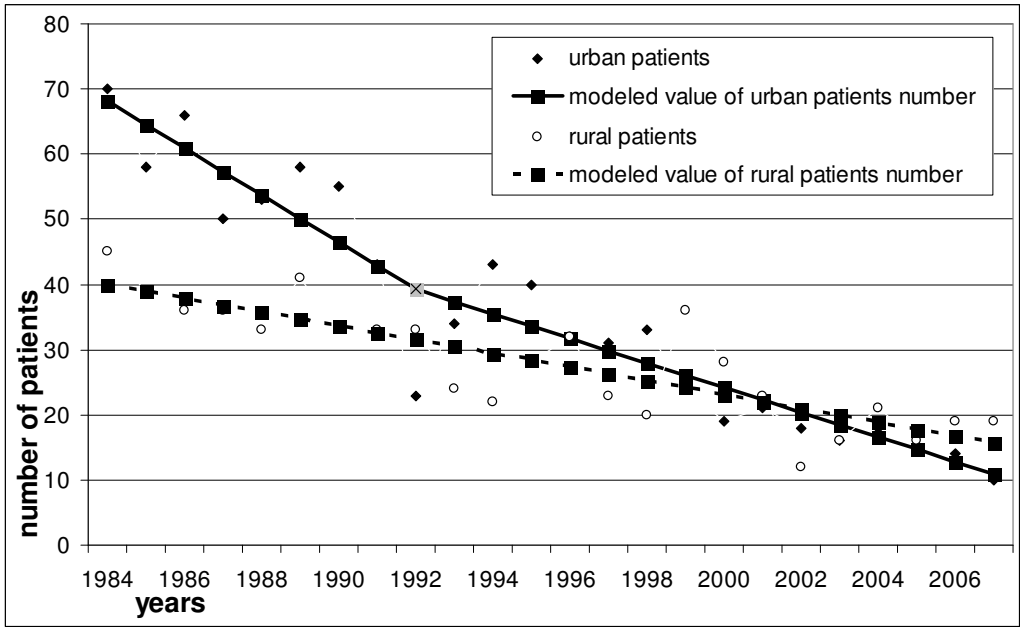

Fig. 13. Trends of changing number of residence place of patients, to whom replantations were performed

We have found a difference of various social groups' sizes change trends during the investigation period (Fig. 14). In the beginning of the investigation

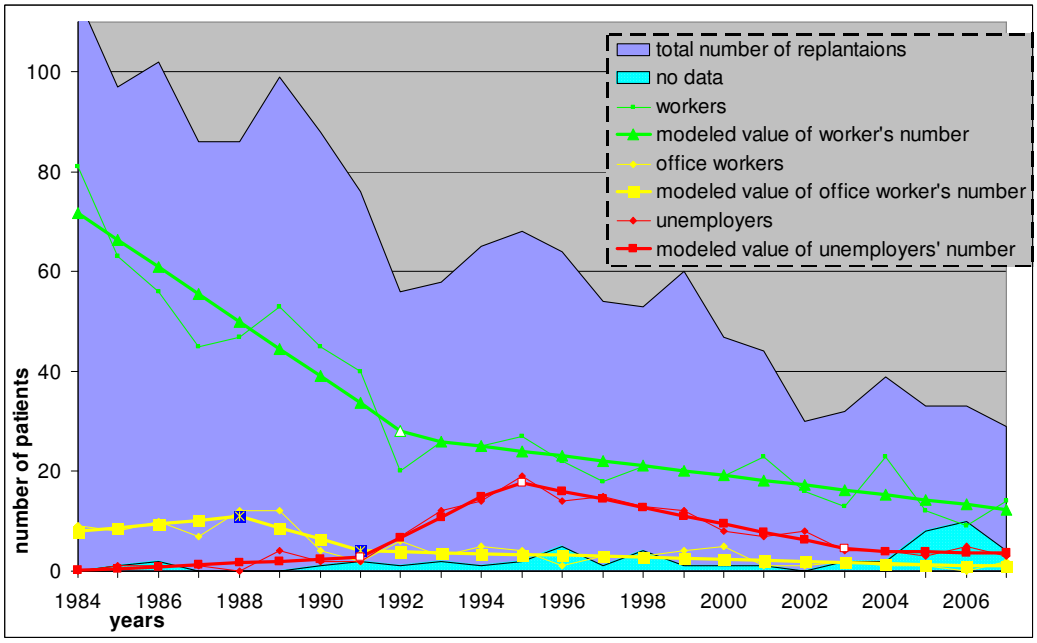

Fig. 14. Trends of changing numbers of various patients social groups replantations

more than two-thirds of patients were workers. JPR estimated one joinpoint for modeled curve of workers' group changing size. The group size decreased fast (b=–5.45; t=–7.520; p<0.001) during 1984–1992 and slowly during 1992–

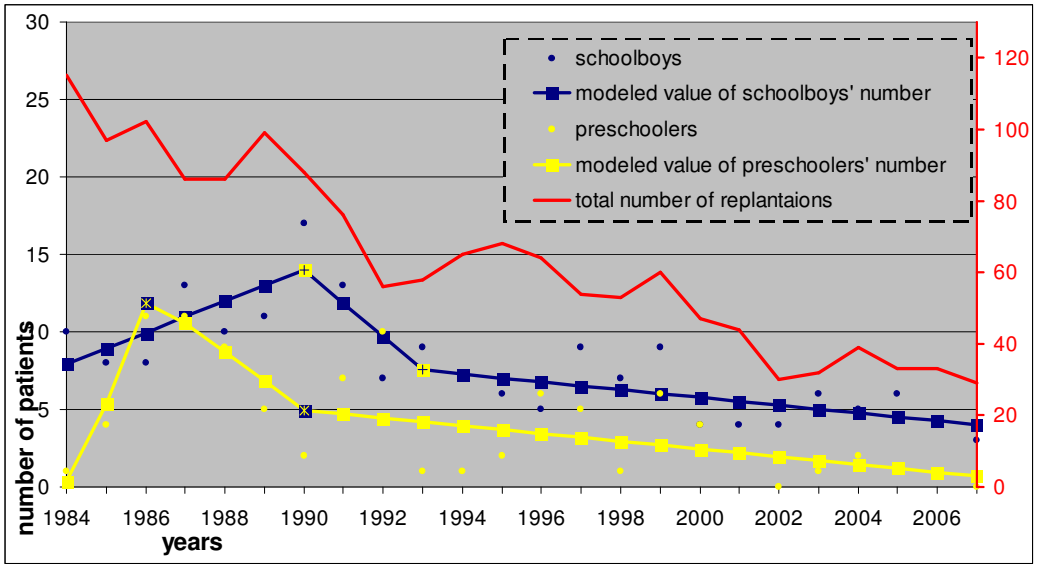

Fig. 15. Trends of changing numbers of schoolers' and preschoolers' replantations

2007 (b=–0.975; t=–3.018; p=0.007). The office employees' group size increased slightly till 1988 and decreased slightly during 1988–1992, and did

not change until the end of the investigation period (b=–0.196; t=–2.695; p=0.016). Unemployed patients were very rare till 1991. The total number of unemployed patients increased during 1991–1995 by four patient per year (t=4.502; p<0.001). 27.9 % patients were unemployed in 1995. The total number of unemployed patients decreased during 1995–2003 (b=–1.65; t=–9,.42; p<0.001) and did not change during 2003–2009. The total number of schoolboys increased by one patient per year during 1984–1990 (t=2.519; p=0.022) (Fig. 15). From 1990 to 1993 the number decreased by two per year. During 1993–2007 the number of schoolboys did not change very much. During 1984–1986 the total number of preschoolers increased by five kids per year (t=3.73; p=0.007). The size of this group was decreasing since 1986 (1986–1990: b=–1.876; t=–1.159; p=0.262 and 1990–2007: b=–0,251; t=–2,213; p=0,041).

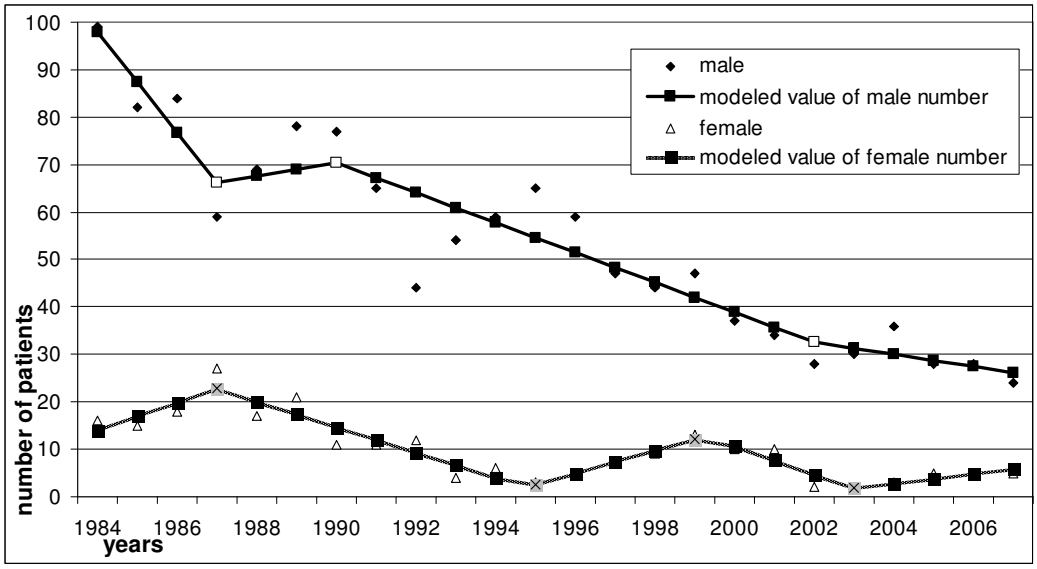

Fig. 16. Trends of changing numbers of male and female patients replantations

The male/female number's change trends are presented in Figure 16. During 1984–1987 the total number of males decreased very fast (b=–10.592; t=-2.102; p=0.056) while total number of females slightly increased (b=2.909; t=1.707; p=0.114). The total number of males increased during 1987–1990 (b=1.390; t=0.138; p=0.892) and decreased from 1990 to the end of the investigation period (1990–2002: b=–3.139; t=–4.619; p<0.001 and 2002–2007: b=–1.296;

t=–0.575; p=0.575). The total number of females fluctuated during investigation period. The number decreased by 2.7 during 1987–1995 (t=–5.896; p<0.001), increased during 1995–1999 (b=2.400; t=2.715; p=0.019) decreased again in 1999–2003 (b=–2.955; t=–1.733; p=0.109) and increased again by one female during 2003–2007 (t=0.936; p=0.368).

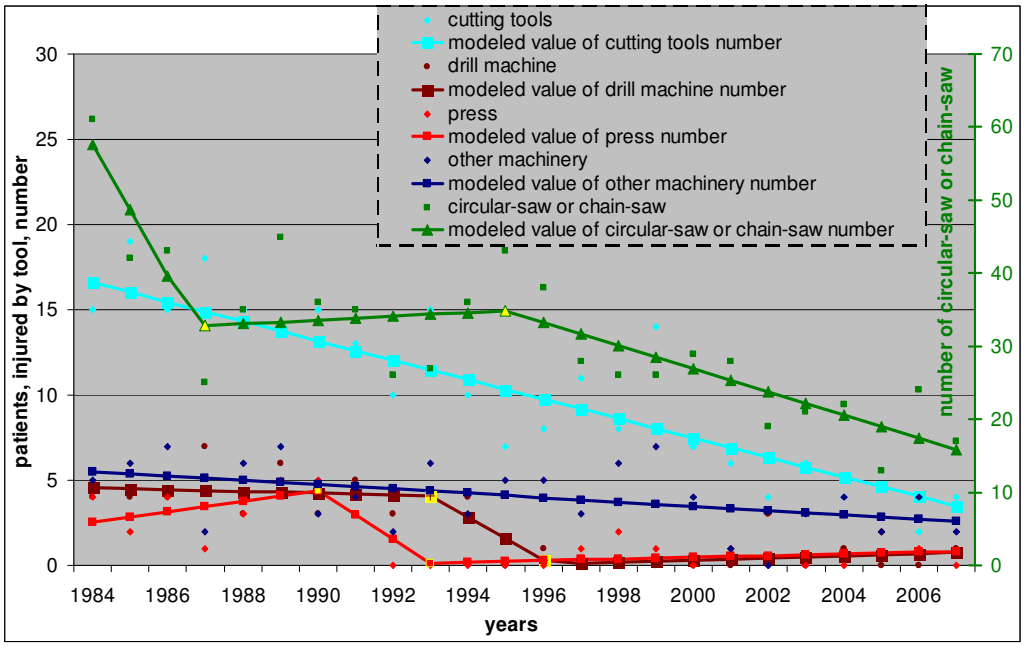

Fig. 17. Trends of changing numbers of various injury tools, which replantations were made, replantations

The changing numbers' trends of injury tool are presented in Figure 17. The most common injury tool was circular-saw/chainsaw. During 1984–1987 the total number of amputations made by this type of injury tool decreased by nine cases per year (t=–2.303; p=0,034). During 1987–1995 the number was almost the same and decreased during 1995–2007 (b= 1.591; t=–3.444; p=0.003). JPR did not evaluate any joinpoints for cutting tools and other machine tools. The total number of cutting instruments decreasing was more significant (r^2=0.693; b=–0.570; t=–7.051; p<0.001) than decreasing the number of other machinery tools (r^2=0.693; b=–0.570; t=–7.051; p<0.001). The total number of drilling-machine and press was more prominent in the middle of the investigation period. These injury tools were very rare during the second half of investigation period.

Determination dependencies between various variables and the survival rate of replanted segment.

Replants survived for 1392 (88.49 %) of the patients, did not survive for 123 (7.82 %), and partially survived or survived not all replanted segments for 58 (3.69 %) patients.

Determination dependencies between non-medicine variables and the survival rate of replanted segment.

We haven't found any statistical significance between these variables: patients' age, residence (urban, rural), injured hand (left, right), trauma place (work, home) and survival rate of replanted segments. We have found significant difference ($p<0.001$) between male and female survival rate of replanted segments. There were no difference of replants' survival rate between smokers and non-smokers (n=961, medical cases, where the fact of patient's smoking or non-smoking was marked). The replants' survival rate depends ($p=0.006$) on the amputation grade (total, subtotal), if not to pay attention to what kind of blood vessels (arteries or arteries and veins) were sutured. There was no significant survival rate difference between replantation after total amputation and subtotal amputation if both arteries and vein were sutured. We have found statistical significance ($p<0.001$) between amputation type and survival rate of replanted segments. The survival rate was 93.71 %, 90.37 % and 77.59 % for replantations after guillotine, crush and avulsion amputations respectively. Table 13 presents survive ratio of different amputation levels replantations. The survival rate difference is statistically significant ($p<0.001$). The lowest survival rate was for finger and forearm replantations.

Determination dependencies between medicine variables and the survival rate of replanted segment.

At the first stage, the OR of the segment survival ratio with 95% CI and the contingency tables of the group of patients that used the medications and the group of patients that did not use the medications were computed. The most

important medications for the survival ratio of the replants in the general comparison of all patients were antibiotics (OR: 1.720; 95% CI: 1.120–2.641) and analgesics (OR: 1.618; 95% CI: 1.108–2.421); the lower margins of the CIs of only these medications were larger than one. The OR and 95 % CI for other medications were 1.239 and 0.837–1.829 for aspirin, 1.167 and 0.709–1.923 for sedative, 0.830 and 0.547–1.259 for antispasmodics, and 0.981 and 0.548–1.755 for fraxiparine. These results were more controversial when the patients were stratified into groups according to amputation type, grade, and level. Firstly, the importance of the medications decreased in the cases of more extensive comparing to the less extensive injuries. Secondly, results showed contrary effect of some medications for survival rate in different groups. Finally, most of the 95% CI of the OR included number one, especially in the group of more extensive injuries. For example, the OR for dextrans was 1.6 for crush amputations and 0.629 for amputations non-finger levels. The OR of sedatives was 0.711 for subtotal amputations and 1.291 for total amputations. In the second stage, we have assessed the dependency between the medications and the survival rate of replants using the binary logistic method. The binary logistic regression model of one block variables didn't yield statistically significantly results with the Nagelkerke r^2 values being below 0.1. Therefore, we used two block binary logistic regression model instead. In the model, we have included two blocks of predictors: the non-medications and medications. The non-medication predictors included the sex, injury tool, amputation type, amputation grade (total, subtotal), and amputation level. These predictors (in terms of Pearson chi-square and Fisher Exact tests with $p<0.05$) were statistically significant predictors for the prediction of the survival rate of the replants. The medication predictors included dextran, analgesics, sedative, antibiotics, fraxiparine, aspirin, dipyridamole, anavenol and antispasmodics. We were able to achieve statistically significant results ($p<0.001$) using two block binary logistic regression model. Antibiotics and analgesics had the highest OR. 95 % CI of all medicine predictors included number one.

In the third stage, we did not find statistically significant difference between the survival rate of the replants over different years of the investigation period (p=0.056).

DISCUSSION

Patients' socio-demographic data

During the investigation period, 1573 patients underwent upper extremity replantations. The main amputation type was crush amputations (74.57 %) equally described in the literature. It is difficult to compare results of our study with literature data due to the absence of unified nomenclature of amputation type, grade. Various authors use different classifications of amputations types and have different approach on what to call subtotal amputation. So, it is impossible to compare results of different sources. Wide ranging overviews of large numbers of replantations are very rare. The most common publications are publications of short narrow series of replantations or analysis of narrow certain problems such as thumb replantation, replantations in children and so on. Epidemiological socio-demographic studies or replantation are rare, too. Very few and incomplete epidemiological and socio-demographic data can be found additionally to clinical data only.

The main injury tools of amputation were circular-saw and chainsaw. More than half of the amputations were caused by these injury tools. According to literature, saw and machine-tool are the commonest injury tools for upper extremity amputations.

We found only one literature source about work/house amputation ratio. Two-thirds of amputation occurred at work and one-third occurred at home in Sweden during 1979. We get the opposite result in our study – almost two-thirds of the patients injured at home. We believe high amputation at home rate is due to frequent use of saw and cutting tools at home, in breach of safety rules. We found, 25–44 years old group patients were operated most often. The patients' average age is almost 33 years. These data do not differ from literature data: average age varies from 24 to 36 years.

Most patients (83.85 %) were operated due to finger amputations. It does not differ form literature data. All over the world finger replantations are common and higher level replantations are rare. Male-female ratio was 5 to 1 in our study. All literature sources show the same data. Male-female ratio did not depend on the place of residence (urban/rural) in our study. But women more likely than man have amputations at work.

Trends during investigation period

During all investigation period the total number of upper extremity replantations decreased. In the beginning of the investigation period (1984–1987) more than one-hundred replantations per year were performed. The total number of replantations increased in 1982, when the public found out about replantation possibilities in National Microsurgery Center. The total number of replantation decreased three times during 25 years. Analyzing the causes of decrease it is important to distinguish three main directions: a) possible decrease of total number of amputations; b) correction of indications for replantation and c) establishment of new replantation centers in Lithuania. It is impossible to determine the causes of decreased number of upper extremity amputations. There is no unified registry of amputations and replantations in Lithuania. A lot of patients after amputations are operated in local hospitals (replantations are not performed there) and do not access replantation centers in Vilnius or Kaunas. In the beginning of the investigation period, National Replantation Centre was a single replantation center in Lithuania (and Latvia, Estonia also). In the beginning of 1990s two additional centers were established in Lithuania: in National Vilnius University Hospital and in the Hospital of Lithuanian University of Health Sciences Kaunas Clinics. Our Plastic and Reconstructive Department of Vilnius University Hospital Centro Affiliate is the largest replantation center in Lithuania till nowadays. It is difficult to count and compare replantation data of three replantations centers due to not publishing data and due to the problem of different use of terms in replantology.

Some patients after an amputation do not undergo a replantation in our hospital either. These patients are operates in outpatient operating room of emergency department. The records of these patients were not included in inpatient department registry books and were not analyzed in this study. We analyzed inpatient department patient's records of our hospital only.

If the decrease of the total replantation number was due to the decrease of total amputation number, this decrease must be similar in all groups of amputation level, grade, and type etc. However, we obtained different results in our study. We found two periods of rapid decrease of the total replantation number in 1990–1992 and 1999–2002. During 1990–1992 we noticed rapid decrease of replantation after amputations at work number, while the number replantations of amputations at home did not change. The trend of decrease replantation number after amputations at work is similar to the trend of decrease of total amputation number ($b \approx 9.3$). The decrease of amputations at work can be attributed to improvement in safety at workplace and with the changes in political and economic situation when Lithuania became independent in 1991. The closure of many factories also influenced the decrease of work traumas. During this period the decrease of the number of workers is observed also ($b \approx 5.4$). We observed the decrease ($b \approx 9.8$) of fingers replantations' number during 1990–1992, while the number of replantation of higher level was very similar. So we made a conclusion that the rapid decrease of replantations' number in 1990–1992 was due to the decreased finger amputations at work mostly.

During the second rapid decrease of total replantation number in 1999–2002, all patient groups (divided by patient sex, amputation type, grade, and level) decreased very similarly. We found the difference in decrease of the number of amputations at home. But we cannot explain the rapid decrease of total replantation number by the decrease of amputation/replantation number at home. So we made the decision that the replantations number's decrease was due to decrease of total amputation number. The decrease of total replantation

number is found in other Western Europe countries, and did not change in USA.

We found specific changes in average patients' age during the investigation period. In the beginning of investigation period till 1992 the patients' average age decreased. We found out, that this decrease was mostly due to a large number of children operated. Assessing the relationship between social groups, the relatively large number of preschool-age children and students was observed at this period. From 1992 to 1994 the average patients' age increased dramatically from 28.29 yr. in 1992 to 39 yr. in 1994. During this period the number of children and students decreased. Form 1994 to 1997 the patients' average age decreased to 30.5 yr. We think these sharp fluctuations of patients' average age were due to changes in economic, social and politic situation in Lithuania. After the declaration of Independence in 1990, March 11, a lot of factories were closed. People lost their usual jobs. A new personal business type with new unusual tools developed. Unemployment became usual in Lithuania. From 1997 to the end of investigation period the average patients' age increased almost one year per one investigation year. In other words, during this period the same age people group was operated. From 1997, the number of youth (0–14 yr.), young adults (15–24 yr.) and middle adults (25–44 yr.) decreased).

We have found a difference between male's and female's numbers' changing trends. The total number of male patients decreased during all the investigation period except short period in 1987–1990. The number of male patients decreased three times during the investigation period. The number of female patients ranged from 2 to 27 per yr. (average – 10) during the investigation period. In the last years of the investigation period the number of female increased, while the number of male decreased. Extrapolating of recent trends can be operated to predict male and female number equalization.

We found patients' number changes of different social groups during investigation period due to political, economic and social changes in Lithuania. During 1989–1992 the number of amputations/replantations at work and the

number of workers decreased. From 1991 the amputation/replantation number of unemployers increased. The peak of unemployed was in 1995 when 19 patients of 65 had no job. The change of the number of office workers reflects changes of total office workers in Lithuania during the investigation period. The number of office workers increased till 1989 and decreased after 1989.

During 1984–1990 the number of schoolboys increased. These patients injured in professional technical schools during learning process mostly. After 1990 yr. the popularity of these schools decreased and amputations' number in these schools also decreased.

Determination dependencies between non-medicine variables and the survival rate of replanted segment.

The survival rate of replanted segment depends on the extent of soft tissue and bone injury during the amputation. The survival rate of replantation after total amputation is worse than after subtotal amputation. But there is no significant difference (p=0,817) between the survival rate of replantation after total amputation (86.38 %) and subtotal amputation if arteries and veins must be sutured during operation (85.17 %). Replants' survival rate after guillotine amputation is better than after crush amputation. Replants survival rate depend on the amputation type (guillotine, crush, avulsion). Replants' survival rate after avulsion amputation is the worst. These data do not differ from literature data. Higher extent of soft tissue and vessels injury leads to higher vascular complications (thrombosis, vasospasm) rate.

The survival rate of replanted fingers is worse than more proximal level replants. It can be explained by a) slow blood flow in smaller diameter of vessel and greater chance for thrombosis and b) difficult and more precise surgeon technique needed to suture small vessels. We found the difference in replants' survival rate while amputation was made by various injury tools, depended on amputation type made by these injury tools. The worst replants survival rate is if the segment was amputated by a press or drill-machine because of high avulsion type amputation rate. The best replants' survival rate

is if segment was amputated by cutting instruments, because of high guillotine type and very low avulsion type amputation rate.

There are a lot of data about smoking harm to wound healing, circulation disturbance. Smokers have a higher complications rate after replantations. However, we did not find statistically significant difference between smokers and no-smokers rate. We believe the absence of a significant difference was due to paying too little attention to marking the smoking or non-smoking fact to patients' case records. Firstly, the notification about smoking was not noted in more than one-third case records at all. Secondly, according to existing rules we mark if a patient is smoker or a non-smoker at the beginning of hospitalization and do not pay attention to smoking history, cigarette type and so on.

There is no difference between male and female replants survival rate according to literature data. Some authors determined higher replants survival ratio of female due to less extensive injury during amputations. We found opposite results in our study. Female's replants' survival ratio was worse than this of males. 14.4 % of female replants did not survive comparing to only 6.58 % for male. We tried to explain it by the difference in amputation type (guillotine, crush, and avulsion) proportion. 54 cases of 250 female amputations (21.6 %) were avulsions comparing to 14.13 % (187 of 1323) for males. On the other hand, we found a higher percent of guillotine amputations among females (22.40 %) comparing to guillotine amputations among males (7.79 %). The difference between injury tools proportion and the difference between amputation grades (total, subtotal) was too small to explain male and female replants survival ratio. So we could not explain the difference between male and female replants survival ratio. Our study data are not enough to explain this difference of survival ratio without additional data.

Other variables such as injury place (at work, at home), patient's residence place (urban, rural), which hand was injured (left, right) did not influence the survival ratio of the replants.

Determination dependencies between medications and the survival rate of replanted segment.

We analyzed the dependencies between the medications and the survival ratio of the replants in three ways: a) evaluation of the replants survival ratio's odds ratio with 95% CI and the contingency tables of the group of patients that used the medications and the group of patients that did not use the medications, b) using two block binary logistic regression model to determine influence of all the used medications to the replants survival ratio, and c) comparing the survival ratio replants in various years during the investigation period because different medications were used in various years of the investigation period. We had similar results for dependencies of medications for replants survival ratio in all three ways of analysis. In first way, the evaluation of the replants' survival ratio's while medicine was and wasn't used, we found the highest replants survival OR was while antibiotics and analgesics were used. Replants' OR of anticoagulants was much lower. Replants survival OR's using medicines values was not high at all. OR using antispasmodics were less than one. That means replants had a worse chance to survive if patient prophylactically used antispasmodics. We calculated 95 % CI of replants survival OR and found the lower margins of CI were lower than one except replants' survival ratio using antibiotics or analgesics. That means we cannot extrapolate our study results to population. We obtained controversial results while splitting the total group of patients to smaller groups by amputation level, type, and grade. The results of replants' survival OR using various medications differed in every group. The prophylactic use of the same medication increased replants survival OR and decreased in another. We found lower OR value of replants survival ratio using certain medications in groups where replants survival ratio was predicted by other variables (for example – in finger avulsion group).

During the second type of determination – calculation of dependencies between prophylactic use of medications and replants survival ratio we used binary logistic regression model. We did not get statistically significant results

if we used one block binary logistic regression model in which only medications as predictors were included. We got statistically significant results if we used two block binary regression model. But Negelkerke r^2 was very low, too (0.091). That means more variables, which has importance to replants survival ratio must be included to the binary logistic regression model to get significant results with higher determination coefficient value. Also that means that the importance of medications to replants' survival ratio was low in our study. On the other hand we have to say that the use of binary logistic regression model is complicated when one group is dominant.

We did not find a significant difference between replants' survival ratio in different years of the investigation period. The "p" value is low – 0.053. So, we can say the difference is almost statistically significant and medications almost have importance to replants survival ratio. But it is not true. We found significant difference of variables values, which had statistically significant importance to replants survival ratio during the investigation period. They are: amputation type (guillotine, crush, and avulsion), amputation grade (total, subtotal), injury tool and patient sex. The significant value's differences of these factors are analyzed in the trend section of this study. The low "p" value of difference of replants survival ratio during various years of investigation period was due to these differences of non-medical variables values.

We could not find significant importance of prophylactic medication's use for better replantation survival ratio. This study was retrospective. It is important to perform prospective experimental studies on human to prove or deny results of our study.

CONCLUSIONS

1. The majority of 1942 amputations (1573 patients) were crush amputations made by circular or chain-saws. The replantations' number made due total and subtotal amputations was similar. The four-fifths of all replantations were finger replantations. Male: female patients' ratio was 5:1. Workers were the most common patients. Two-third of amputations occurred at home and one-third occurred at work.
2. We have found a more than three times decrease in the number of upper extremity replantations during this period. We have found two main periods of rapid decreases. During the first period (1984–1989) the number of replantations decreased due to a reduced quantity of amputations at work and a reduced number of finger amputations and replantations. The second period of rapid decrease (2000–2002) was due to the total decrease of the number of amputations.
3. Replants' survival ratio depended on variables, which determined tissue injury extent in an amputated part and stump. These variables were amputation type, amputation grade, injury tool. The percent of females whose replants did not survive was more than two times greater than among males. The percent of survived replanted fingers was lower than more proximal ones.
4. The prophylactic use of medications did not significantly impact replants' survival ratio.

RECOMMENDATIONS

1. Not to use the term “revascularization” instead of “replantation” when describing replantation of subtotally amputated segment. Not to call subtotal amputation the injuries with evidence of blood circulation in amputated segment.
2. To reduce usage of prophylactic medications for preventing vascular complications after upper extremity segments replantations.
3. To perform more prospective experimental studies on human to prove or deny results of our study and to determine effectiveness of prophylactic usage of medications for improving survival rate of replants.

PUBLICATIONS

1.Mažeika Š, Stundžaitė-Baršauskienė G, Vitkus K. Viršutinės galūnės segmentų replantacijų 25 metų apžvalga (*Overview of upper extremity replantations during last 25 years*). Lietuvos chirurgija 2010; 8(2):72–82.

2. Mažeika Š, Vitkus K. Replantacijos. Sąvokos: apžvalga, analizė (*Replantations. Terms: overview, analysis*). Sveikatos mokslai 2010; 6:3709–3714.

3. Mažeika Š, Venalis A. Viršutinės galūnės segmentų replantacijos: 1983–2007 metų tendencijos (*Upper extremity segments’ replantations: 1983 – 2007 years trends*). Visuomenės sveikata 2011; 3: 107–115.

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SANTRAUKA

Tyrimo tikslas

Išanalizuoti viršutinės galūnės segmentų replantacijų atskirus klinikinius ir socialinius veiksnius bei jų dinamiką, nustatyti ir įvertinti jų reikšmę replantatui prigyti.

Tyrimo uždaviniai

1. Išanalizuoti pacientų, kuriems 1983–2007 metais po amputacijos buvo replantuoti viršutinės galūnės segmentai, sociodemografinę charakteristiką.
2. Įvertinti viršutinės galūnės segmentų replantacijų ir jų veiksnių dinamiką ir galimas dinamikos priežastis 1983–2007 metais.
3. Įvertinti nemedikamentinių veiksnių reikšmę replantuotam viršutinės galūnės segmentui prigyti.
4. Įvertinti medikamentinių veiksnių reikšmę replantuotam viršutinės galūnės segmentui prigyti.

Ginamieji teiginiai

1. Replantacijų skaičius 1983–2007 metais VUL Santariškių klinikų Centro filialo Plastinės ir rekonstrukcinės chirurgijos skyriuje mažėjo. Šį mažėjimą skirtingais etapais lėmė skirtingos priežastys.
2. Replantatams prigyti turėjo reikšmės amputacijos tipas, lygis, paciento lytis, traumos įrankis.
3. Po replantacijų profilaktiškai skiriami medikamentai turėjo antraeilę reikšmę replantatams prigyti.

Darbo mokslinis naujumas

Darbe pirmą kartą apžvelgta ir išanalizuota didžiausio ir seniausio Lietuvoje centro, kuriame atliekamos replantacijos, dvidešimt penkerių metų replantacijų medžiaga. Įvertinti amputuotų rankos segmentų replantacijų atskiri klinikiniai

ir socialiniai veiksniai bei nustatytas jų tarpusavio ryšys. Išanalizuotos replantacijų skaičiaus mažėjimo tendencijos ir jų priežastys bei klinikinių ir socialinių veiksnių kitimo dinamika ir priežastys. Atskirai išnagrinėta klinikinių veiksnių ir naudotų medikamentų reikšmė replantatams prigyti. Paneigta visuotinai pasaulyje nusistovėjusi nuostata, kad profilaktinis medikamentų vartojimas turi didelę reikšmę replantatui prigyti.

Darbe atlikta skirtingai replantologijoje vartojamų terminų analizė ir pasiūlytos jų vartojimo rekomendacijos.

Metodika

Šio retrospektyvinio tyrimo objektas – VUL Santariškių klinikų Centro filialo Plastinės ir rekonstrukcinės chirurgijos skyriuje 1983–2007 operuotų ir gydytų pacientų, kuriems replantuotas kuris nors (ar keli) viršutinės galūnės segmentai (pirštas (-ai), delnas, plaštaka, dilbis ir t .t.) po visiškos ar dalinės amputacijos, ligos istorijos.

Šio tyrimo metu tiriamųjų ligos istorijos buvo atrinktos pagal tokius kriterijus:

a) pacientui įvyko trauma, kurios metu buvo dalinai arba visiškai amputuotas viršutinės galūnės segmentas; amputacijos metu buvo pažeista kraujotaka bei skeletas;
b) atlikta operacija – replantacija, kurios metu būtinai buvo atkurta kraujotaka replantuotame segmente, nepaisant to, ar replantuotas segmentas prigijo ar ne.

Duomenims įvesti ir pirminiam apdorojimui atlikti naudota *MS Access* programa, analizė daryta *MS Excel, SPSS, Mintab* , *JMP*, *Joinpoint Regression* programomis. Statistiškai reikšmingais ir patikimais laikyti rezultatai, kai „p“ reikšmė buvo mažesnė nei 0,05. Kiekvienu atveju būdavo nurodoma reali „p“ reikšmė vienos tūkstantosios tikslumu. Jei ši reikšmė būdavo mažesnė, būdavo nurodoma „p<0,001“.

Duomenų analizėje išskirtos trys tyrimo kryptys:

1. <u>Bendrųjų duomenų analizė, pacientų sociodemografinės charakteristikos nustatymas.</u> Vertinti kiekybiniai ir kokybiniai kintamieji. Kiekybiniai

kintamieji, nagrinėti suskaičiuojant jų kaip kiekybinių kintamųjų parametrus: vidurkį, medianą, modą, standartinį nuokrypį, imties plotį ir t.t. Vertinant, ar yra nepriklausomumas tarp kokybinių kintamųjų, naudoti Pearsono Chi-kvadrato ir tikslusis Fischerio testai. Nustatant ranginių kategorinių kintamųjų tarpusavio ryšį apskaičiuotas Spearmano neparametrinis koreliacijos koeficientas bei jo patikimumas. Vertinant normalaus skirstinio kintamuosius, skaičiuota linijinės regresijos kreivė. Norint patikrinti, ar kintamais yra pasiskirstęs pagal normalųjį skirstinį, skaičiuotas Kolmogorovo–Smirnovo testas.

2. Amputacijų/replantacijų skaičiaus dinamika tiriamuoju laikotarpiu. Duomenys apdoroti naudojant lūžio taškų regresijos programą.
3. Replantato prigijimo ir veiksnių tarpusavio priklausomybės nustatymas**.** Vertinta nemedikamentinių ir medikamentinių veiksnių (medikamentų) priklausomybė su replantato prigijimu.
    a. Nemedikamentinių veiksnių priklausomybės su replantato prigijimo kintamuoju nustatymas. Naudoti Pearsono Chi-kvadrato ir Fisherio tikslusis testai.
    b. Medikamentinių veiksnių ir replantato prigijimo kintamojo tarpusavio priklausomybės nustatymas. Vertinta replantato prigijimo priklausomybė nuo po operacijos profilaktiškai naudotų medikamentų (ar jų grupių). Medikamentinių veiksnių reikšmė replantatui prigyti nustatinėta trejopai: a) vienmatės keturženklių lentelių analizės metodu; b) dvinarės daugiafaktorinės logistinės regresijos modeliu; c) palyginant tarpusavyje replantatų prigijimą skirtingais tiriamojo laikotarpio metais.

Rezultatai

Iš 1573 pacientų, kuriems replantuoti viršutinės galūnės segmentai, daugiau nei pusė (799 pacientai) operuoti dėl visiškos amputacijos. Dažniausias amputacijos tipas – traiškytinė amputacija (74,57 proc.). Pacientai, kurie gydėsi mūsų centre dažniausiai susižalodavo diskiniu ar grandininiu pjūklais.

Beveik du trečdaliai pacientų susižalojo buityje. Manome, kad buityje dažniau susižalojama dėl dažno diskinių ir grandininių pjūklų bei kertančių pjaunančių įrankių naudojimo ne darbo metu, nesilaikant saugaus darbo taisyklių. Tai patvirtina mažiausias iš visų socialinių grupių bedarbių, replantatų prigijimo procentas (81,05 proc.). Dažniausiai susižalojo subrendę pacientai (25–44 m.). Pacientų amžiaus vidurkis siekia beveik 33 metus. Vertinant amputacijos lygį, nustatyta, kad dažniausiai pacientams replantuoti pirštai (83,85 proc. pacientų). Vyrams penkis kartus dažniau nei moterims replantuoti amputuoti viršutinės galūnės segmentai. Vyrų ir moterų santykis nepriklausė nuo gyvenamosios vietos (mieste/kaime), bet moterys dažniau už vyrus žalojasi darbe.

Vertinant visą tiriamąjį laikotarpį, nustatytas replantacijų skaičiaus sumažėjimas mūsų centre. Tiriamojo laikotarpio pradžioje 1984–1987 metais per metus buvo atliekama ~100 replantacijų. Paskutiniais tiriamojo laikotarpio metais replantacijų skaičius sumažėjo tris kartus. Vertinant bendrą replantacijų skaičiaus mažėjimą, išskirti du staigūs amputacijų skaičiaus sumažėjimai. Pirmasis staigus sumažėjimas buvo 1990–1992 metais, po kurio iki 1999 metų per metus atliekamų replantacijų skaičius skyrėsi nedaug. Antrasis ryškesnis sumažėjimas įvyko 2000–2002 metais. Nuo 2002 metų iki tiriamojo laikotarpio pabaigos replantacijų skaičius nedaug skyrėsi. Pirmojo replantacijų skaičiaus mažėjimo periodu labiausiai mažėjo amputacijų darbe skaičius, kai tuo pat laikotarpiu amputacijų buityje, dėl kurių buvo atliktos replantacijos, skaičius išliko toks pats. Traumų darbe skaičiaus mažėjimo kreivė savo nuolydžiu atitinka bendro replantacijų skaičiaus mažėjimo kreivę ($b \approx 9,3$). Darbo traumų mažėjimą galima sieti su gerėjančia darbo sauga ir su pasikeitusia ekonomine padėtimi, Lietuvai iškovojus Nepriklausomybę, kai užsidarė dalis fabrikų, kuriuose ir įvykdavo daugiausia traumų. Šiuo laikotarpiu iki 1992 metų mažėjo ne tik traumų darbe, bet ir susižalojusių darbininkų skaičius ($b \approx 5,4$). Taip pat pirmuoju bendrojo amputacijų skaičiaus mažėjimo periodu labiausiai mažėjo pirštų amputacijų skaičius ($b \approx 9,8$). Kitų amputacijos lygių replantacijos skaičiaus kitimas buvo nežymus. Šiuo periodu visų pacientų amžiaus grupių mažėjimas buvo panašus. Tačiau pirmaisiais

tiriamojo laikotarpio metais didėjo replantacijų vaikams skaičius. Dėl to iki 1991 metų operuotų pacientų amžiaus vidurkis nuolatos mažėjo. Įvertinus aukščiau apraštytus skaičiavimus, galima daryti išvadą, kad replantacijų skaičiaus mažėjimą lėmė traumų darbe, kurių metu buvo amputuojami pirštai, mažėjimas. Antruoju replantacijų skaičiaus mažėjimo etapu 1999–2001 metais, mūsų tyrimo duomenimis, beveik visi tirti rodikliai (amputacijos lygiai, tipai, pacientų, gyvenančių mieste ar kaime, vyrų ir moterų skaičius, visos socialinės grupės) mažėjo. Manome, kad replantacijų skaičiaus mažėjimą, daugiausia lėmė bendro amputacijos skaičiaus mažėjimas.

Tyrimo metu nustatyta, kad replantato prigijimas priklausė nuo to, kaip stipriai traumos metu buvo sužalotas amputatas ir bigė bei kokią kraujotaką reikėjo atkurti replantacijos metu. Replantato po visiškos amputacijos prigijimo rezultatai buvo prastesni nei po dalinės. Tačiau, jei palyginti visiškos ir dalinės amputacijos, kai replantacijos metu būtinai buvo atkurta ir veninė kraujotaka, rezultatus, statistiškai reikšmingo skirtumo nėra. Mūsų tyrimo metu nustatyta, kad rūkymas prigijimui reikšmės neturėjo. Tačiau vienareikšmiškai šio teiginio vertinti negalima. Pirma, daugiau nei trečdalyje ligos istorijų paciento rūkymo ar nerūkymo veiksnys apskritai nebuvo užfiksuotas. Antra, pacientai pagal ligos istorijose nurodytus duomenis nebuvo skirstomi pagal surūkomų cigarečių skaičių, nikotino ir dervų koncentraciją jose bei rūkymo laiką, o fiksuojamas tik paciento tuo metu deklaruojamas rūkymo ar nerūkymo, kaip žalingo įpročio, faktas.

Radome, kad moterims replantatai prigydavo blogiau nei vyrams. Tai galima susieti su didesne moterų plėštinių amputacijų proporcija – 21,6 proc. (54 atvejai iš 250) ir šiek tiek dažnesnėmis stambių segmentų replantacijomis, kurių prigijimas taip pat buvo blogesnis. Be to, moterys dažniau nei vyrai operuotos dėl visiškos amputacijos, po kurios prigijimo tikimybė yra mažesnė nei replantuojant dėl dalinės amputacijos. Kita vertus, moterų grupėje daugiau nei trigubai didesnis giljotininių amputacijų procentas. O po šio tipo amputacijos replantacijos segmento prigijimo tikimybė yra didesnė. Be to,

vertinant lyties ir traumos įrankio priklausomybę, tose grupėse, kur segmentų prigijimas yra blogesnis (gręžimo staklės, diskinis/grandininis pjūklas), moterų amputacijų procentas yra mažesnis. Kalbant apie labiau žalojančius faktorius, moterų procentas yra didesnis tik tarp susižalojusiųjų presu. Bet vertinant absoliučius skaičius, ši grupė yra labai maža – tik aštuoniolika atvejų iš 250. Todėl vien pagal mūsų tyrimo duomenis atsakyti, kodėl šis vyrų/moterų replantatų prigijimo skirtumas yra ženklus, neįmanoma. Paaiškinti, kodėl moterims blogiau prigijo replantatai reikalingi papildomi tyrimai. Mūsų tyrimo duomenimis, kiti tirti faktoriai: traumos vieta (darbe/buityje), paciento gyvenamoji vieta (mieste/kaime), kuri ranka buvo sužalota (kairė, dešinė), naudotas nejautros tipas replantacijos metu, replantatams prigyti reikšmės neturėjo.

Medikamentų reikšmė replantatams prigyti tirta keliais būdais: a) nustatinėtas replantato prigijimo šansų santykis vartojant ir nevartojant kiekvieną medikamentą ar jų grupę; b) sudarytas dviejų blokų logistinės regresijos modelis, į pirmą bloką įtraukiant nemedikamentinius veiksnius, o į antrą – vartotus medikamentus; c) vertinant, ar yra skirtumas tarp replantatų prigijimų skirtingais tiriamojo laikotarpio metais, nes skirtingais metais po replantacijų buvo naudoti skirtingi medikamentai. Suskaičiavus prigijimo šansų santykį, vartojant/nevartojant medikamentus, gautas šansų santykis buvo nedidelis. Didžiausia replantatų prigijimo šansų santykio reikšmė gauta vertinant ne krešėjimą veikiančius ar kraujagyslės spazmą mažinančius medikamentus, o antibiotikus ir analgetikus. Naudojant vieno bloko logistinės regresijos modelius, kai į modelius kaip nepriklausomi kintamieji buvo įtraukti tik medikamentai, nepavyko sudaryti statistiškai reikšmingo modelio su bent kiek didesniu Negelkerke determinacijos koeficientu. Naudojant dviejų blokų logistinės regresijos modelį, kai į pirmąjį bloką buvo įtraukti papildomi veiksniai, turintys reikšmės prigijimui, pavyko gauti patikimą modelį, galintį paaiškinti jau 9,1 proc. visų atvejų. Kitų replantatų prigijimo šiuo modeliu paaiškinti negalime. Tai rodo, kad, be šių nagrinėtų kintamųjų, yra daugybė

kitų veiksnių, kurie turi didelę reikšmę replantatui prigyti. Ir trečiuoju atveju – vertinant replantatų prigijimą skirtingais tiriamojo laikotarpio metais, kai skirtingais metais buvo vartojami skirtingos medikamentų schemos, nerasta patikimo replantatų prigijimo skirtumo. Gauta „p“ reikšmė buvo artima patikimai (0,053). Bet, tai lengvai galime paaiškinti skirtingu replantato prigijimui turėjusių veiksnių (paciento lyties, amputacijos tipo, lygio, rūšies, žalojančio veiksnio) pasiskirstymu įvairiais tiriamojo laikotarpio metais.

Išvados

1. Iš 1983–2007 m. replantuotų 1942 viršutinės galūnės segmentų (1573 pacientams) vyravo traiškytinės amputacijos, o dažniausiai susižalota diskiniu pjūklu. Replantacijų dėl visiškų ir dalinių amputacijų skaičius beveik vienodas. Pirštų replantacijos sudarė keturis penktadalius visų replantacijų. Vyrai operuoti penkis kartus dažniau nei moterys. Didžiausia operuotų pacientų socialinė grupė – darbininkai. Du trečdaliai amputacijų įvyko buityje, o trečdalis – darbe.
2. Tiriamuoju laikotarpiu atliekamų replantacijų skaičius per metus sumažėjo tris kartus. Išskirti du žymaus sumažėjimo periodai. Pirmąjį sumažėjimą 1990–1992 m. daugiausia lėmė amputacijų darbe, kurių metu mažiau amputuota pirštų, skaičiaus sumažėjimas. Antrąjį žymų replantacijų skaičiaus sumažėjimą 2000–2002 m. lėmė bendro amputacijų skaičiaus sumažėjimas.
3. Replantatui prigyti turėjo reikšmės tie nemedikamentiniai veiksniai, nuo kurių priklausė bigės ir amputato sužalojimo apimtis: amputacijos tipas, amputacijos rūšis, žalojantis įrankis. Taip pat nustatyta, kad pirštų prigijimo procentas buvo mažesnis nei stambesnių segmentų. Moterų replantatų neprigijimo procentas dvigubai didesnis, palyginti su vyrų.
4. Profilaktinis medikamentų naudojimas po replantacijų turėjo mažą reikšmę 1983–2007 m. replantuotiems viršutinės galūnės segmentams prigyti.

Rekomendacijos

1. Nevartoti termino „revaskuliarizacija“ vietoje „replantacija“, aprašant nevisiškai amputuoto segmento prisiuvimą, o didelių sužalojimų, kai segmentas laikosi nors ir ant mažo audinių tiltelio, bet turi pakankamą kraujotaką, nevadinti daline amputacija.
2. Mažinti po replantacijų ir autotransplantacijų profilaktiškai naudojamų medikamentų, skirtų išvengti kraujagyslinių komplikacijų, vartojimą,
3. Remdamiesi mūsų tyrimo rezultatais, siūlytume atlikti klinikinius tyrimus, patvirtinančius arba paneigiančius profilaktiškai vartojamų medikamentų veiksmingumą replantatų ir autotransplantatų prigijimui gerinti.

Disertacijos tema paskelbtos publikacijos

1. Mažeika Š, Stundžaitė-Baršauskienė G, Vitkus K. Viršutinės galūnės segmentų replantacijų 25 metų apžvalga. Lietuvos chirurgija 2010; 8(2):72–82.
2. Mažeika Š, Vitkus K. Replantacijos. Sąvokos: apžvalga, analizė. Sveikatos mokslai 2010; 6:3709–3714.
3. Mažeika Š, Venalis A. Viršutinės galūnės segmentų replantacijos: 1983–2007 metų tendencijos. Visuomenės sveikata 2011; 3: 107–115.

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Kalbos: lietuvių, anglų, rusų