

Hydrocolonotherapy ankle joints after injuries

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Purpose: to improve efficiency of hydrokinesotherapy by means of specially designed devices and monolasts for patients after ankle joint injuries.

Material & Methods: there are pedagogical methods, clinical and radiological methods, anthropometric measurements and goniometry were used.

Results: the author's technique of hydrokinesotherapy with application hydrokinesomechanotherapy device in the program of physical rehabilitation which provides optimum conditions for the recovery process was developed.

Conclusions: the specially designed hydrokinesomechanotherapeutic device and monolasts are allow strictly controlled movement in all planes of the ankle joint, which contributes to the acceleration of the recovery; the conducted anthropometric and goniometric studies were indicate more rapid elimination of edema, increase movement amplitude, carries opposition to the development of contractures and muscle atrophy.

Keywords: ankle-joint injure, physical rehabilitation, hydrokinesotherapy, hydrokinesomechanotherapeutic device, monolast.

Introduction

Fractures, which are connected damages of intershin – 10,5%, make 60% in the structure of injuries of a talocrural joint (G. S. Yumashev, 1990; O. M. Myatiga, 2004). The desirable result isn't always achieved, despite of an application of modern methods of conservative or operational methods of treatment of fractures with the use of means of physical rehabilitation. A significant amount of complications in the form of contractures, rigidities, muscular atrophies, flat-footedness, violations of the arch of foot, support ability of the injured extremity, gait is observed. The combination of these factors can result in disability which arises almost in half of patients at heavy breaks of a talocrural joint [2; 3; 5; 6; 13–15]. It is proved that desirable results can be achieved at use of devices of mechanic-therapy in the water environment which principle of actions is based on biomechanical features of movements in joints and properties of water. However the existing mechanic-therapeutic devices not completely provide the movements in water inherent in a talocrural joint which reduces the efficiency of a hydrokinesotherapy and process of renewal. Therefore the development of new hydromechanical devices which are capable to provide the mobility volume in a joint, to reduce post-traumatic motive complications, not to allow invalidization of a person is relevant not only from the medical but also social and economic point of view.

Communication of the research with scientific programs, plans, subjects

The work is performed according to the plan of the research work of NNIFK of A.S. Makarenko Sumy state pedagogical university of MES of Ukraine for 2007-2011 by the subject "Theoretic-methodological and organizationally-me-

thodical problems of health, physical rehabilitation and correctional pedagogics" (number of the state registration is 0107U002826), and by the subject "The increase of the level of health and physical fitness of different groups of the population by means of physical culture" (number of the state registration is 0111U005736) for 2011-2015.

The purpose of the research

To increase the efficiency of hydrokinesotherapy by means of specially designed hydrokinesomechanotherapeutic device and monoflippers for patients after damages of a talocrural joint.

Research task:

1. To analyze features of the designs of the existing mechanotherapeutic devices and to define technological shortcomings which influence efficiency of renewal of functions of a talocrural joint.
2. To design hydrokinesomechanotherapeutic device, monoflippers and to develop hydrokinesotherapy technique for patients after damages of a talocrural joint.
3. To estimate efficiency of an author's technique of hydrokinesotherapy with the use of hydrokinesomechanotherapeutic device and monoflippers in the system of physical rehabilitation of patients after damages of a talocrural joint.

Material & Methods

The research was carried out on the basis of the Ukrainian scientific research institute of traumatology and orthope-

dics of AMS of Ukraine (Kiev). We examined 57 persons after damages of a talocrural joint. The contingent of patients was distributed on the main (MG – 29 persons) and comparative (CG – 28 persons) groups. Research methods: pedagogical methods, clinic-radiological data, anthropometrical measurements, goniometry.

Results and discussion

Unsatisfactory results of treatment after fractures are observed in 5–37% of patients among whom nearly a half becomes disabled people (O. Ye. Loskutov, 1990; L. A. Dvoynin, 2002; V. I. Dubrovskiy, 2004). One of the major factors, that allow to reduce undesirable consequences of damages of the SMA and to increase quality of treatment, is physical rehabilitation. The need of application of means of physical rehabilitation for complex treatment after fractures is proved by the theory and practice (M. V. Kornilov, E. G. Gryaznukhin, 2004; A. V. Maglyovany, 2006; S. M. Popov, 2006; V. M. Bogolyubov, 2007; V. P. Murza, V. M. Mukhin, 2015).

Some authors distinguish hydrokinesotherapy (HKT) from means of physical rehabilitation as a powerful factor in the prevention and elimination of morphofunctional violations after removal of an immobilization. At the same time according to V. I. Dovgan, S.B. Temkin, 1981; O. F. Kaptelin, 1986; H. F. Riegler, 1987; L. I. Fisenko, 2005, the efficiency of application of physical exercises in water raises on condition of use a portable mechanotherapeutic device. However technological parameters and operating modes of devices which were used by authors not always allow to work differentiated on inherent biomechanical properties to a talocrural joint (TJ).

The use of special mechanotherapeutic devices gives the chance to improve functional results of the recovery process, to reduce the duration of the period of temporary not working capacity, to prevent the development of complications and disability. But not always the technological modes of known mechanotherapeutic devices (block, paperweight, and cylinder objects) allow to influence differentiated and effectively displays of a traumatic illness, the majority of them have only one plane of movements. Among others mechanotherapeutic devices of different modifications are often used (A. s. No. 1773403 USSR, Pat. No. 2033780 RU, A. s. No. 1416123) which not always give the expected results or not adapted for use in water. Shortcomings of devices are:

- impossibility of performance of the passive and actively facilitated movements in TJ from average-physiologic starting positions for the elimination of contractures;

- impossibility of regulation and fixing of a tilt angle in TJ of rather basic surface of foot which doesn't give the chance to carry out accurately dosed movements at early stages of physical rehabilitation;
- absence of goniometric means which allow to carry out monitoring of movements in a talocrural joint.

Despite of shortcomings, some of them provide a complex of passive and active movements, but don't allow fixing accurately average-physiologic situation for performance of frontal movements in TJ and limiting performance of the dosed actively facilitated physical exercises.

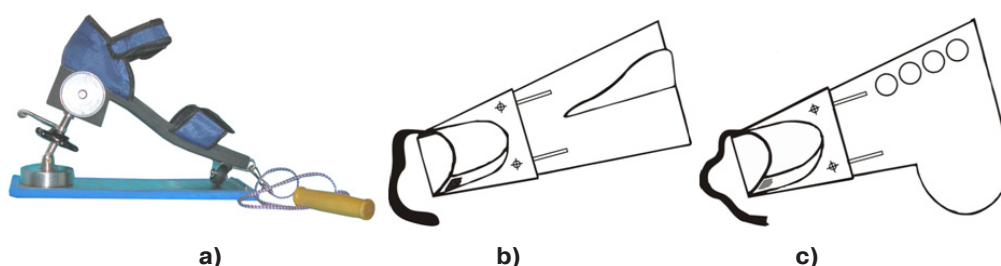
Flippers of different designs are considerably adapted for conditions of the water environment and to performance of movements in all planes. However the majority of them make impossible conditions for performance of exercises with an essential resistance of water in sagittal, frontal and horizontal planes, and movements of joints of a back department of foot which reduces efficiency of rehabilitation.

Therefore, technical capabilities of the known devices allow fighting against consequences of fractures, but not capable to provide the differentiated movements with different degree of activity, muscular tension, and possibility of their performance in all planes which are peculiar to joints of a back department of foot.

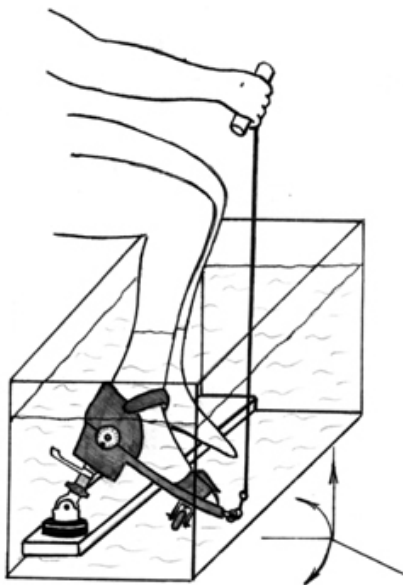
The analysis of scientifically-methodical literature and practical experience allowed us to develop an author's technique of hydrokinesotherapy in the program of physical rehabilitation with application of specially designed hydrokinesomechanotherapeutic devices (HKMTD) and monoflippers for patients after damages of a talocrural joint. The performance of such physical exercises was its feature: autopassive, active facilitated by means of HKMTD (pic. 1a), active with use of monoflippers (pic. 1b, c), tractions; application to hydromassage in a bathtub «Relax» and the dosed walking in the pool with the different level of immersion.

Autopassive exercises in water from the first days of the post-immobilization period were carried out for mobility renewal, tension of hems, prevention of contractures and strengthening of the copular device TJ (pic. 2).

The patient was consistently suggested executing the movements of bending extension in sagittal and inversions-aversion of foot in the frontal planes by means of a flexible draft. Loads of the operated extremity increased gradually due to the formation of a right or acute angle between foot and a longitudinal



Pic. 1. Author's devices for the development of a talocrural joint:
a – hydrokinesomechanotherapeutic device;
b – monoflippers for movements in the frontal and sagittal planes;
c – monoflippers for movements in the sagittal plane.



Pic. 2. Hydrokinesomechanotherapeutic device for the development of a talocrural joint

nal axis of a shin. The initial angle reached by means of goniometer and the HKMTD constructive elements which made 40–45°. Gradually this corner was reduced to 10-15° with elimination of pain and increase in amplitude of movements.

The autopassive movements were carried out at slow speed, with gradual finishing amplitude of movements to the greatest possible. At the end of each movement the short delay to easy painful feelings with the sufficient force of external action was carried out, at the same time exercises were carried out with the prolonged exhalation phase. The number of repetitions of each exercise – 18–20 times.

The active facilitated exercises were a transitional chain between autopassive and active free exercises. They began with movements in the frontal plane (inversion-aversion) by means of the built-in roller in the nasal part of the device and muscular effort. Loads of the damaged segment of the lower extremity during a performance of the offered physical exercises was dosed by means of different tilt angles of a foot from 40° to 10°, the angle is smaller, and the bigger loading is. The angle was established which answered 10-15° for the reduction of pain at the end of each movement and achievement of a certain level of fitness. The number of repetitions of each exercise – 14–16 times, speed is slow, amplitude incomplete, and breath is any. During a performance of exercises, the movements were limited which repeated the trauma mechanism, severely adhering to a certain tilt angle of a foot.

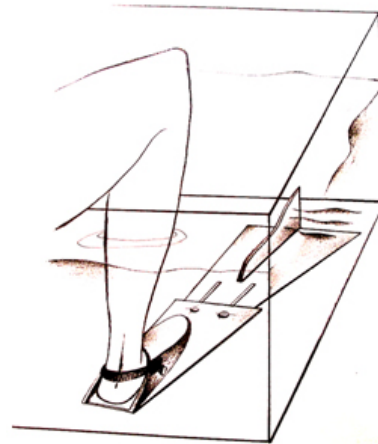
We used monoflippers for the increase in power load of shin muscles: monoflippers for movements in the sagittal plane; monoflippers for movements in the frontal and sagittal planes (pic. 3a).

The author's technique of hydrokinesotherapy with use of specially designed monoflippers to movements in TJ was applied in a complex of rehabilitation actions after the education of a secondary bone callous:

a) monoflipper for movements in the sagittal plane; s.p. – sitting on a side to the pool, legs are shipped in water to knees:



a)



b)

Pic. 3. Monoflippers for rehabilitation of TJ:
a – monoflippers for movements in the sagittal plane;
b – monoflippers for movements in the frontal and sagittal planes.

bending extension in TJ, a knee joint; features of a design of a monoflipper provided tension of the joint-copular device on the one hand of TJ, and strengthening of muscles from the opposite side; change of position of the rowing blade of a monoflipper on 180° caused a opposite effect of action on tissue;

b) monoflipper for movements in the frontal and sagittal planes; s.p. – the same that in the point "a": bending extension, inversion-aversion in joints of a back department of foot; features of a design of a monoflipper provided strengthening of muscles, the accuracy and coordination of performance of movements which promoted stabilization articulate and the copular device of TJ and increase of an support ability of an extremity.

Physical exercises were carried out on average speed, with incomplete amplitude, the number of repetitions of 20-25 times at the beginning of the training period, speed, amplitude and the number of repetitions (40–50 times) increased gradually at the end.

Hypostases of soft fabrics of foot and lower third of a shin, succulence of its forward surface, manifestation of an at-

rophy of muscles, restrictions of volume of movements in TJ and violation of a gait were observed before the beginning of application of hydrokinesotherapy for sick of both groups. Phys-rehabilitation actions were already applied to sick of both groups before carrying out during this period anthropometrical and goniometric researches. But sick of MG were engaged according to individually developed program of physical rehabilitation [3], and sick of CG by the standard techniques [4; 8; 13; 15–17]. Therefore results of a difference of the contoured sizes of separate segments of the lower extremity for the 50th day after the operation had reliable differences between indicators of MG and CG where conditionally the best indicator was observed at sick of MG. There weren't reliable differences between indicators of MG and GP by the results of the goniometric measurements during this period, and indicators of volume of the movements of TJ remained low with sick of both groups.

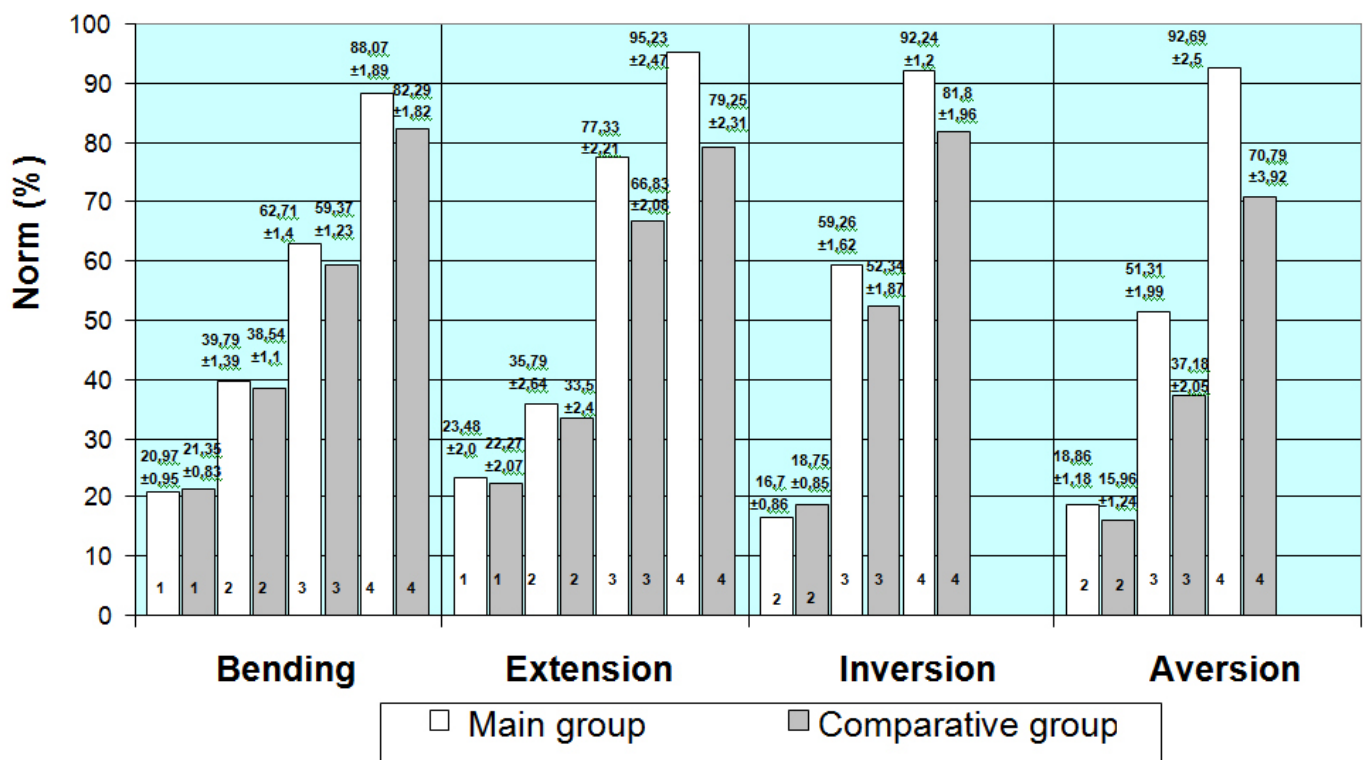
Measurement of the contoured sizes of separate segments of the injured extremity was shown reduction of hypostases at sick of both groups. At the end of the rehabilitation course the difference of the contoured sizes of the TJ at sick of MG made $0,4 \pm 0,04$ sm, the lower third of a shin – $0,3 \pm 0,03$ sm, an average third of a shin – $-0,17 \pm 0,03$ sm, and in CG – respectively $1 \pm 0,04$, $0,8 \pm 0,03$ and $-0,74 \pm 0,03$ sm. The fact of reduction of hypostases and hypotrophy of muscles of sick of MG in comparison with sick of CG is statistically reliable ($p < 0,001$).

The final result of measurement of volume of active movements in a talocrural joint and a joint which is above a heel of sick of both groups showed that they changed positively in comparison with the initial level (pic. 4).

Despite of the positive dynamics of increase in volume of active movements, its incomplete renewal was observed at patients with the heavy complicated changes, difficult reconstructive operations, bigger traumatism of tissues, intra-articulate and adjacent to TJ, associated diseases. The bigger quantity of sick of CG, in which the worst result of rehabilitation was observed, probably is connected with not carrying out autopassive exercises by means of HKMTD and non-use of a monoflipper of sagittal movements for the alternate, differentiated action on lateral and medial parts of a talocrural joint.

Conclusions

1. The features of designs and technical parameters of functioning of the existing hydromechanotherapy devices don't ensure the movements in the planes of a talocrural joint characteristic of its natural biomechanical properties that influences efficiency of hydrokinesotherapy.
2. The hydrokinesomechanotherapy device and monoflippers, which allow carrying out severely dosed movements in all planes of joints of a back department of foot, are designed and the technique of their use in the complex recovery process is developed.
3. The conducted anthropometrical and goniometric researches demonstrate the acceleration of elimination of hypostases, increases in amplitude of movements; counteract of the development of contractures and an atrophy of muscles. The difference the contoured sizes between the injured and healthy extremity made $0,4 \pm 0,04$ sm at the level of the TJ seg-



Pic. 4. Dynamics of indicators of volume of active movements in a talocrural joint and a joint which is above a heel of the injured extremity (in percentages):
 1) the 5th day after the operation; 2) the 50th day after the operation; 3) the 70th day after the operation; 4) the 5th month after the operation

ment, the lower third of a shin – $0,3\pm 0,03$ sm, an average third of a shin – $0,17\pm 0,03$ sm, and patients have groups of comparison – respectively $1\pm 0,04$, $0,8\pm 0,03$ and – $0,74\pm 0,03$ sm that indicates the fact of a bigger reduction of hypostases and hypotrophy of muscles in the first, than secondly ($p < 0,001$). The amplitude of active movements in a talocrural joint and a joint which is above a heel of the injured extremity approached a norm in both groups, however the number of patients of the main group who managed to renew almost completely until the end of the rehabilitation course mobility, was 1,2 times more, than in the group of comparison. The volume of movements of bending made $88,07\pm 1,89\%$ from a norm, extension, – $95,23\pm 2,47\%$, inversion – $92,24\pm 1,2\%$, aversion – $92,69\pm 2,5\%$ at the first one; at the second – respectively $82,29\pm 1,82$, $79,25\pm 2,31$, $81,8\pm 1,96$ and $70,79\pm 3,92\%$ from

a norm.

4. Positive results of approbation in practice of the author's technique of hydrokinesotherapy with application of hydrokinesomechanotherapeutic device and monoflippers in the recovery process allow recommending its for use in the system of physical rehabilitation of patients after damages of a talocrural joint.

Prospects of the subsequent researches

Is are considered by us in studying of the efficiency of application of designed hydrokinesomechanotherapeutic device and monoflippers at sports injuries of a talocrural joint.

Conflict of interests. The authors declare that there is no conflict of interests.

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