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STUDY OF THERAPEUTIC MANAGEMENT IN LOWER LIMB PEDIATRIC TRAUMA

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Abstract: *Amputations of limbs, in terms of traumatic pediatric afflictions, are sparse, but severe indispositions that can become very uncomfortable for the ones involved. The role of the orthopedic or the plastic surgeon is crucial here, for she or he needs to preserve as much as possible from the viable physis in order for the bond development of the child to still happen. In following steps, a wound examination should be done to check for symptoms of ischemia or tissue non-viability. Some problems, such as neuromas, can be avoided by dividing the nerves proximally. A multidisciplinary approach involving physiotherapists, play therapists, and a child psychiatrist, in addition to the surgeon and primary care practitioners, may lead to a successful recovery.*

Key words: *Management; Pediatric; Trauma; Recovery; Residual limb.*

1. Introduction

Trauma is one of the leading causes of death and morbidity in children over the age of one year all old all around the globe [2]. Initial pediatric trauma care and cardiopulmonary resuscitation [12]. From the beginning of mankind, it has been proven that there have been various traumatic conditions in primitive man.

The principles of the small communities of mankind endured these during the search for food, but also in the struggle with the forces of nature and wild animals.

The first means of treatment and recoveryafter traumatic aggression, which referred strictly to fractures, appeared described in the works of Hippocrates (460-377 BC).

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At the beginning of our era, Aurelius Cornelius Celsus defined the four signs of infection that appeared as a consequence of open trauma.

The development of traumatology, as a science in its own right, experienced a rise around the years 1700 - 1750, with the descriptions and analyzes of Percivall Pott. It describes for the first time an ankle fracture with bimalleolar interest, at the level of the moving pillar.

In 1895 - Roentgen discovers the rays with which he succeeds in studying the bones and at the beginning of the 20th century; the first osteosyntheses obtained with the help of metallic materials appeared.

Among the traumatic sufferings enunciated and developed by traumatology, this paper develops the topic of bimalleolar fractures. There have been many debates about fractures over the past few decades.

These take place at the level of the skeletal system, by interrupting the continuity of the bone-component material of the living organism, as a result of an aggressor with energy and force that exceeds the resistance of the locomotor system. Bimalleolar fractures are fractures that require careful therapeutic management and meticulous recovery, because this area is meant to support the entire weight of the body, having a very important static and dynamic role.

2. Methods

The human shank and foot complex is a complex, multi-joint system that allows the lower limb to communicate with the ground during locomotion. The ankle complex, which is made up of the ankle (or tibiotalar) and subtalar (or talocalcanear) joints, is an important part of the human locomotor system, since it is involved in almost every locomotion operation. The inferior tibiofibular and fibulotalar joints also play a role in the ankle joint complex, but this isn't discussed in detail in this article. Studies of human joints from the geometrical point of view seek to demonstrate how ligament orientations and articular surface shapes can direct the movement of bones toward each other within their permissible range of motion. Mechanical experiments, in contrast, demonstrate how ligaments, muscles, and articular surfaces work together to transfer load from one bone to the next within their permissible range of motion, and how they interact to determine the range of motion. Comprehending the structure and responsibility of all passive structures in the natural ankle joint is critical for designing joint replacements that can completely bring back original joint function. For an effective mechanical analysis of the joint's response to external load, awareness of the changing geometry of the passive structures across the range of passive flexion is essential. These processes are also responsible for joint mobility and stability. The natural range from maximal combined eversion–dorsiflexion to maximal combined inversion–plantarflexion (49° at the ankle, 30° at the subtalar) displayed a much smaller difference. The average joint rotations in the three anatomical planes during the stance process of walking were found to be about 15°, 8°, and 8° at the ankle joint, and about 7°, 10°, and 7° at the subtalar joint. At first, combined motion at these two joints was thought to be a rotation around a single or double fixed axis. Joint motion patterns were studied in depth, but all of them were based on the same premise. Recent research has shown that during passive dorsiplantar flexion, the instantaneous axis of rotation converts and rotates, implying that the hinge joint term is an oversimplification. Other ligament fibres were neglectful of the majority of the passive dorsi-plantar flexion range, tightening only at one or both of the motion's limits. These results point to a close relationship between ligament geometry and articular surface form in directing and stabilizing ankle joint motion. The multi-axial coupled motion observed experimentally during passive motion was then explained using three-dimensional (3D) computer-based geometrical kinematic models of the tibiotalar articulation. Initially, two one-degree-of-freedom spatial equivalent mechanisms for the passive motion simulation of the tibiotalar joint were suggested. The mechanisms were constructed on the presumption that the joint passive structures, such as ligaments and articular surfaces, play a guiding role and that their geometric dimensions are important. These presumptions included isometricity of fibers inside the calcaneofibular and tibiocalcaneal ligaments, as well as rigidity of the articulating surfaces, which were represented by three sphere-plane contacts in one model and a single spherical pair in the other. Despite the fact that the movement forecast by the models was fairly consistent with that measured in corresponding specimens, significant differences were found. The oversimplifications used to describe anatomical structures, especially the complex articular surfaces in spheres and planes, accounted for this. Later on, a surgical navigation device with cluster of active markers was utilized to gather more detailed skeletal kinematics and anatomical geometry of the passive structures, i.e. articular surfaces and attachment areas of the ligaments, by digitisation with a pointer. Three sphere-to-sphere touch points and two rigid connections were used to describe an analogous spatial mechanism for the passive motion simulation. Two touch points were found at the lateral talofibular articulation and two at the tibial mortise and trochlea tali articulation. The isometric fibres at the calcaneofibular and tibiocalcaneal ligaments defined the two rigid connections. The final geometrical parameters resulting from an iterative refinement process were identified using an optimisation algorithm that aims for the best match between model predictions and corresponding experimental measurements of spatial motion. The original passive motion from corresponding specimens was very well reproduced by the specimen-specific analogous spatial mechanisms. The research also shows that the articular surfaces and ligaments work together as a mechanism to regulate the ankle joint's passive kinematics in a complex 3D direction of motion. The passive structures of the ankle joint, in particular, were shown to be capable of guiding the complex triplanar motion, which involves about 45° flexion in the sagittal plane and about 4-5° and 7-8° rotations in the frontal and transverse planes, respectively. The ankle works under load during everyday activities. Ligaments stretch or slacken in response, and articular surfaces in touch indent. The passive motion models described above specify the initial configuration of these joint structures at each flexion angle, from which the final configuration under load can be incrementally determined, as described in the upcoming paragraphs.

Woodburnet al. [20] showed that, in these patients, when walking barefoot or in shoes, a painful valgus deformity of the rearfoot is associated with extreme eversion at the ankle complex and internal rotation of the shank. In comparison to a control group, the RA group had a longer stance time, shorter stride duration, higher cadence, and slower walking speed; at the backfoot, they had delayed and decreased plantarflexion, increased external rotation, and increased inversion, which was in contrast to previous findings. Turner and Woodburn [3] recorded decreased plantarflexion in terminal stance and increased eversion at the rearfoot in RA patients with extreme forefoot, rearfoot, or combined deformities. They discovered a variety of distinct gait patterns among the patients in those classes.

3. Participants and Procedure

In addition to external forces, motion at the ankle and subtalar joints is regulated by osteoarticular and ligamentous structures and caused by the forces and moments of extrinsic muscles. A clearer understanding of the physiological mechanisms of the ankle complex is also needed to improve understanding of diseases and relevant conservative and surgical treatments. Motivation for scientific research involving bimalleolar fractures imports a deeper initiation into kinetic recovery, being also a family reason.

Approaching this topic is a topical issue, encountered both in orthopedic practice and in physical therapy.

The chosen theme has the role of highlighting the beneficial role of kinetic therapy in limiting the period of physical suffering applied after the period of immobilization. Following the identification of children with bimalleolar fracture and follow-up of individualized applied therapeutic management, the recovery of cases referred to kinetic recovery centers in the orthopedic service at 4-6 weeks or other periods after plaster removal is analyzed.

4. Objectives

1) Identification of cases with bimalleolar fractures that arrived in an emergency at ERU Children Brasov.
2) Establishing seasonality.
3) Summary of the age segment with the highest incidence.
4) Study of risk factors.
5) Analysis of certainty signs and radiological signs.
6) Evaluation of the therapeutic management applied to each subject.
7) Estimation of the results of the kinetic recovery programs within the re-evaluation of the cases at 4-6 weeks in the orthopedic Ambulator from the HospitalPolyclinic.

We are based on a retrospective study, conducted during the years 2018-2019, in the Emergency Reception Unit (ERU) within the Emergency Clinical Hospital for Children Brasov. The inclusion criterion targeted all patients up to 18 years of age presented in an emergency. The tie-breaking criteria for the interest group were:

- children with ankle injuries with bimaleolar involvement, - we did not include children with polytraumas that affected several.
- we did not include children with polytraumas that affected several segments of the skeletal system,
- with definite signs of fissure / bone fracture in the ankles, the patients who, following the orthopaedic evaluation refused any therapeutic maneuver were not analyzed.

The working method used was based on the retrospective analysis of the data recorded in: ERU files, clinical observation sheets, the hospital's computer base, the register for the records of consultations in the outpatient orthopaedic practice.

Due to the fact that the diagnoses of orthopedic doctors were stated based on the location and type of fracture, all clinical observation sheets with cases of fractures involving the distal 1/3 of the lower limb were analyzed.

In order to conduct medical studies, the members signed a consent by which they gave their written consent to use the data for teaching and analytical purposes.

Statistical analysis and graphical representation were performed using the applications in the Microsoft Office package (Word, Excel and Access).

5. Results

The analysis within the study started on 01.01.2018, time 00.00 and ended on 31.12.2019, time 23.59.

In this study, interest was attributed only to patients with settlements / fracture pathways and / or traumatic ligament pathology accompanying the pathological ankle.

Presentation of the results of the study: In 2018, in ERU Children Brasov, 39,843 patients presented in an emergency regime with various pathologies, out of with 7,766 required hospitalization to remedy the pathological condition and 32,077 cases were discharged at home after: evaluation medical treatment, application of therapeutic management and prescription of medical recommendations (Table no. 1).

In 2019, 38,981 patients presented, of which 18.56% required hospitalization of 1.39%, as shown in Table no. 2.

The ERU files were analyzed in which the clinical diagnoses of orthopedic doctors were recorded and it resulted that bimalleolar fractures were encountered with an average incidence of 1.39%, as shown in Table no. 2.

Table 1

Summary of ERU presentations with various pathologies / year of study and month

	2018					2019				
	Total presenta-tion in ERU	Total inter-born cases	%	Total external cases	%	Total presenta-tion in ERU	Total inter-born cases	%	Total external cases	%
January	2959	521	1,31	2438	6,12	3197	617	1,58	2580	6,62
February	3380	616	1,52	2764	6,94	2863	508	1,30	2355	6,04
March	3421	595	1,49	2826	7,09	3141	596	1,53	2545	6,53
April	3319	664	1,67	2655	6,66	3087	567	1,45	2520	6,46
May	3418	612	1,54	2806	7,04	3213	594	1,52	2619	6,72
June	3221	537	1,86	2684	6,74	3481	582	1,49	2899	7,44
July	3199	632	1,59	2567	6,44	3291	604	1,55	2687	6,89
August	3351	742	1,86	2609	6,55	3294	527	1,35	2767	7,10
September	3070	644	1,62	2426	6,09	3375	605	1,55	2770	7,11
October	3557	752	1,89	2805	7,04	3459	711	1,82	2748	7,05
November	3205	647	1,62	2558	6,42	3265	634	1,63	2631	6,75
December	3743	804	2,02	2939	7,38	3315	691	1,77	2624	6,73
TOTAL	**39843**	**7766**	**19,49**	**32077**	**80,51**	**38981**	**7236**	**18,56**	**31745**	**81,44**

Table 2

	Total presentation in ERUChildren BV		*Cases arrived in the ERU with Bimalleolar fractures*			
	2018	**2019**	**2018**	**%**	**2019**	**%**
JANUARY	2959	3197	48	1,62	52	1,63
FEBRUARY	3380	2863	34	1,01	31	1,08
MARCH	3421	3141	21	0,61	42	1,34
APRIL	3319	3087	36	1,08	28	0,91
MAY	3418	3213	42	1,23	36	1,12
JUNE	3221	3481	58	1,80	61	1,75
JULY	3199	3291	62	1,94	53	1,61
AUGUST	3351	3294	49	1,46	57	1,73
SEPTEMBER	3070	3375	64	2,08	56	1,66
OCTOBER	3557	3459	53	1,49	54	1,56
NOVEMBER	3205	3265	42	1,31	39	1,19
DECEMBER	3743	3315	34	0,91	42	1,27
TOTAL	**398843**	**38981**	**543**	**1,36**	**551**	**1,41**

Identification of cases with bimalleolar fractures that arrived in an emergency at ERU Children Brasov. The analysis shows that there is a higher incidence of bimalleolar fractures in the summer and autumn months, which can be explained by: the increase in the number of sports tourists in camps / camps in the hot season and the return from summer vacation for September, with the resumption of schools. For the subjects of the study it turned out that: - there were 542 cases from Brasov County,- from other counties 502 cases and - from other countries 50 cases.

During the study, an analysis was made in order to identify the age segment with the highest share for children with bimalleolar fracture and it was observed that: 48.43% belonged to the segment from 13 to 18 years in 2018 and 55.17 % in 2019. The therapeutic management applied in the two conditions identifies the use of plaster castings as an indispensable measure.

The following were applied:

- 27.69% femur-plantar type plaster machines
- 72.31% leg-plantar type plaster devices.

All cases received analgesic therapy.

After the discharge of the cases, the patients were invited for the initial evaluation in the orthopedic outpatient clinic of the Polyclinic at 4 weeks for the removal / change of the plaster cast. Considering that a significant part of the study subjects came from other counties or from other countries; 572 cases in the two years of study responded to the initial consultation in the polyclinic.

In the initial control:

- 352 femur-plantar plaster casts with plaster casts were replaced,
- 220 leg-plantar plaster devices were removed;
- subjects without plaster cast were assessed;
- the normo-functional state was identified in 90 subjects → who did not require kinetic recovery;
- the appearance of pain at rest with the foot supported on the ground in 13 subjects → who were directed to the physiotherapy centers;
- occurrence of pain while walking in 98 subjects →
- who required physical therapy,
- occurrence of posttraumatic ankle instability in 19 subjects → who needed physical therapy

Following the gradual abandonment of plaster castings, the physical therapy program aimed to combat pain and resume mobility of the post- traumatic ankle joint.

The medical gymnastics sessions were performed by the group of interest in the private offices.

Normalization of joint function proved to be inversely proportional to the number of kinetic recovery sessions taken.

6. Discussion

The study of cases with bimalleolar fractures that took place in ERU Children Brasov, continued the follow-up of hospitalized cases during hospitalization and submitted their research in the Orthopedic Outpatient Clinic of the Hospital Polyclinic.

Out of the total number of cases arrived in emergency regime with various pathologies, 1094 cases with bimalleolar fractures were identified: 543 cases / year 2018 and 551 cases/ year 2019. The average incidence was 1.39%. The increase in the number of cases with bimalleolar fractures was identified in the summer and autumn months. A plausible explanation appears due to the increase in the number of sports tourists from camps / camps in the hot season and the return of children from the summer holidays for September, with the resumption of schools.

An analysis was performed to identify the age segment for the study subjects and it was observed that 51.83% were between 13 and 18 years old.

The analysis of risk factors highlighted:

- a ratio of 2.38 / 1 for males to females,
- an increase in weight among subjects from the urban environment → of 60.15%,

High BMI had a significant percentage significance → of 37.93%, drug allergies, anemias, gastrointestinal disorders and other bone disorders - had an increased share in the analysis of APP of the study subjects.

It was observed that: 26.05% suffered trauma during recreational activities (cycling, scootering, overboarding, skateboarding…) and 18.10% were registered in performance athletes. Regarding the clinical manifestations, it was noted:

- prevalence of trauma to the right ankle in 83.09% of cases,
- lateral movement of the ankle in 5.12% of cases,
- medial displacement of the ankle in 94.88% of cases,
- functional impotence and severe / moderate pain in 100% of cases.

The proposed therapeutic management was:

- analgot therapy in 100% of cases,
- closed orthopedic reduction and fixation in plaster cast of femoral-plantar type in 20.38% of cases, immobilization in plaster boot 72.30% of cases and surgical approach in 7.31% percent.

The initial assessment for all cases identified with bimalleolar fractures was made one month later, in the Orthopedic Outpatient Clinic. Within this evaluation it was observed that 572 cases out of the total managed in ERU children Brasov.

In this evaluation: femur-plantar plaster castors were changed into plaster boots in 61.54% cases and leg-plantar plaster castors were removed from the rest of the subjects, the subjects were evaluated and monitored, as well as the recommendation for recovery. kinetic. The evolution of the patients presented a favorable ascending curve with the articular normalization which was found in an inversely proportional relation with the physiotherapy sessions they went through.

Regarding the application of recovery sessions through exercises, initially passive, followed by active physical movements, they developed the main reason in early achievement of the proposed goal for each subject.

7. Conclusion

Amputations of the limbs in children under the age of 18 can cause disability and have psychological implications for the amputee. With guidance from a physiotherapist, nursing staff, child psychiatrist, and surgeon, a multidisciplinary treatment strategy is recommended. Parental support and therapy are needed to assist in the identification of appropriate coping strategies for the amputee and his or her family. The key is to keep as much residual limb length as possible to ensure a good outcome with prosthesis after the limb has fully grown. Even though complications are uncommon, they can be debilitating and necessitate frequent monitoring and, if necessary, surgical revisions.

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