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ORIGINAL

Clinical and functional evolution of the fracture of lukewarm managed with external fixation

Evolución clínica y funcional de la fractura de tibia manejada con fijación externa

Emmanuel González Chamant[1], Guillermo Reyes Chirino[1], Lázaro Leduan Cordero Betancourt[1], Mario Mesa Marti[1], Guillermo Breijo Madera[1]

[1]Hospital Abel Santamaría Cuadrado, Departamento de Ortopedia y Traumatología. Pinar del Río. Cuba.

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Corresponding author: Emmanuel González Chamant

ABSTRACT

The modern world has brought I get a vertiginous development rhythm, that is accompanied of increment of accidents with increase of lesions of high complexity, mostly located in the long bones, he/she puts under an obligation to the improvement of the techniques of bony fixation, with the intention of controlling the damages, to achieve the cure of the fractures, to avoid complications and sequels. Objective: To analyze the clinical-functional results of the technique of external fixation in the treatment of the fractures of lukewarm in the patients of the service of Orthopedics and Traumatología of the Surgical Clinical Hospital Abel Squared Santamaría in the period of February of 2020 to September of 2023. The universe was constituted by all the patients entered with fracture of lukewarm (n:73); the sample understands the patients entered with fracture of lukewarm treaties with external fixation (n:23). In the current investigation prevalence of the masculine sex existed in the age range understood from the 26-35 years; the place of more frequent lesion was the half third and the causal factor of more representativeness they were the accidents automivilísticos; as for the communication with the exterior the biggest percentage was given by the open fractures. Most didn't develop complications; however of the patients that if they presented complications the most frequent it was the presence of superficial infections. Therefore; it continues being the external fixer a treatment option adapted since in the handling of the fractures of lukewarm in most of the studied patients satisfactory results they were obtained.

Keywords: Fractures of Lukewarm; External Fixer.

RESUMEN

El mundo moderno ha traído consigo un vertiginoso ritmo de desarrollo, eso se acompaña de incremento de accidentes con aumento de lesiones de alta complejidad, mayormente localizadas en los huesos largos, ello obliga al perfeccionamiento de las técnicas de fijación ósea, con la intención de controlar los daños, lograr la curación de las fracturas, evitar complicaciones y secuelas. Objetivo: Analizar los resultados clínico-funcionales de la técnica de fijación externa en el tratamiento de las fracturas de tibia en los pacientes del servicio de Ortopedia y Traumatología del "Hospital Clínico Quirúrgico Abel Santamaría Cuadrado" en el período de Febrero de 2020 a Septiembre de 2023. El universo estuvo constituido por todos los pacientes ingresados con fractura de tibia (n:73); la muestra comprende a los pacientes ingresados con fractura de tibia tratados con fijación externa (n:23). En la actual investigación existió predominio del sexo masculino en el rango de

edad comprendido desde los 26-35 años; el sitio de lesión más frecuente fue el tercio medio y el factor causal de mayor representatividad fueron los accidentes automivilísticos; en cuanto a la comunicación con el exterior el mayor porcentaje estuvo dado por las fracturas abiertas. La mayoría no desarrolló complicaciones; sin embargo de los pacientes que si presentaron complicaciones la más frecuente fue la presencia de infecciones superficiales. Por tanto; sigue siendo el fijador externo una opción de tratamiento adecuado en el manejo de las fracturas de tibias ya que en la mayoría de los pacientes estudiados se obtuvieron resultados satisfactorios.

Palabras claves: Fractura de Tibia; Fijador Externo.

INTRODUCTION

The modern world, characterized by scientific and technical development, has brought with it a dizzying pace of development, the appearance of high-speed motor vehicles, high-risk jobs, and the loss of a sense of risk in the face of danger, which is often associated with the consumption of alcoholic beverages or other harmful habits.

All of the above has led to an increase in highly complex injuries, primarily located in the long bones of the body, where it is common to find fractures with several fragments and with great bone exposure, which brings with it a high risk of morbidity and mortality both for the damaged limb and for the life of the injured person.

This phenomenon requires traumatologists to constantly search for and perfect bone fixation techniques, with the intention of controlling possible damage, achieving fracture healing, and avoiding complications and sequelae that delay or prevent these patients' reincorporation into their social and working lives.

The earliest examples of fracture treatment in the medical literature date back 5000 years to Egypt. Since then, longitudinal elements were used to immobilize the limbs (wood, especially palm bark), which were attached with bandages. This concept, which has been updated hundreds of times with the introduction of longitudinal splints of various types, is the basis of what is known in external fixation as the linear or rod system.[1] External fixation is a further method of external fixation.

External fixation is just another method of osteosynthesis, having multiple but precise indications.

It is not a modern method. Descriptions of the use of external tutors in the management of fractures can already be found in the works of Hippocrates. The writings of Hippocrates 2,400 years ago describe a method of external skeletal fixation used for the treatment of fractures of the tibia, which allowed treatment of the bony lesion and also inspection and treatment of the soft tissues; it was made of Egyptian leather with a proximal base below the knee and a distal one above the neck of the foot; in which four lateral bars of equal length were placed in resistant wood. This attachment would allow the fracture to be tensioned and held, and the soft tissue involved would be assessed. It was of three different sizes, allowing the fracture to be compressed.[2]

The first report in the literature regarding the treatment of fractures by external fixator dates back to 1840 when Malgaigne used a metal-tipped instrument that rested directly on the displaced bone fragment, with a leather clamp that wrapped around the circumference of the limb to maintain the reduction achieved, the same author presented in 1843 an external fixator for patella fractures, a clamp-shaped device, which he used percutaneously to compress and immobilize fractures of the patella.[3]

Lambotte designed the first mono-lateral external fixator of the last century in 1902, from which all the linear fixators we know are derived. He was also the first to use the term 'external fixator' and the first to introduce organized threaded pins, one proximal and one distal, to the fracture site. Judet presented his fixator in 1932, which he modified in 1940, as we know it today.[4]

Between 1930 and 1950, external fixation fell into disuse in North America because of its significant complications.[5]

In the middle of the 20th century, a fundamental change in the conception of external fixation came about with applying the concept of dynamic fixation. Gavriil Ilizárov, in the Soviet Union, created an annular fixator with his circular fixation system, using pre-stressed transfixing wires, which gave greater stability and rigidity to the designs, beginning his work on bone elongation and dynamization, changing what were devices that maintained the focus of the fracture or osteotomy to thinking in biological concepts and the bone as a living and modifiable tissue. Although their studies began in the 1950s, they were known in the West in the 1970s.[6]

In Cuba, external fixators were introduced by Dr. Alberto Inclán in 1940. The Haynes and Strader fixators and the Charnley fixator were used. In 1976, Professor Rodrigo Álvarez Cambras designed and developed a model of a Cuban external fixator in stainless steel, whose characteristics act as a neutralizer and distractor, with 2 bars through which pistons slid, a bipolar linear model forming a simple frame. In 1978, he converted it into a triple-purpose fixer by adding a compression system: compressor, distractor, and neutralizer. Components were added to give it greater stability: a system of half-arms and a fine wire (stabilizer) that gives it greater stability, preventing the fragments from moving laterally as they are curved, which provides a second plane.[7]

In 1978, the Soviet methodology was introduced at the Central Military Hospital by Doctor Carlos Juan Finlay and Professors Alfredo Ceballos Mesa and David Zayas Guillot. Subsequently, Dr. Ceballos Mesa and Dr. Balmaseda from CIMEQ designed a circular external fixator with thin, tensioned wires, replacing the metal rings with plastic ones, including tensioning cables.[8]

In 1979, a third plane was added to the triple-purpose fixator of Professor Rodrigo Alvarez Cambras: linear, axial, transverse, parallel, and oblique, giving the appliance the shape of an 'L.' At the end of the same year, a new transverse plane was added at 90 degrees, giving it a 'T' shape. This facilitated epiphyseal distraction, and in 1980, a fourth transverse plane was added in a double quadrilateral to transport large and small bone fragments following the axis of the limb, called the quadrilateral bone transporter. 1982, it was modified and could be used as a monopolar fixator, which acts as an external lever for stabilization, distraction, and compression.[8,9,10]

All this motivated the realization of this work, which aims to perform a functional clinical characterization of the external fixation technique in the treatment of tibia fractures in the Orthopaedics and Traumatology service of the Clinical Surgical Hospital Abel Santamaría Cuadrado'. in the period from February 2020 to September 2023.

METHOD

A descriptive, longitudinal, prospective study was carried out on the evolution of tibia fractures treated with external fixation in patients seen in the Orthopaedics service of the Clinical Surgical Abel Santamaría Cuadrado from February 2020 to September 2023.

The universe consisted of all patients admitted with tibia fractures to the Orthopaedic Service.

The sample selected by non-probabilistic sampling comprised the 23 patients admitted with tibia fractures in the orthopedic department who were treated with external fixation and agreed to participate in the research voluntarily and completely confidentially.

As in all health research, empirical, theoretical, and statistical methods play a fundamental role. In the present study, these were applied as follows:

Empirical methods: The primary sources of data collection were documentary review through the analysis of the medical records of patients with tibia fractures who were treated by external fixation; in addition, observation and questionnaire, which were carried out through a mini medical record prepared, which contains the variables investigated, as well as informed consent.

Theoretical methods: The historical-logical method was mainly used, which allowed the construction and development of the scientific theory and the general approach to address the scientific problem.

Descriptive statistics: The data was analyzed descriptively. Absolute and relative frequency distributions were made for all variables.

RESULTS

Table 1. Patients with tibial fractures are treated with external fixation according to age and sex

Age	Sex				Total	
	Male	%	Female	%	No.	%
26 - 35	6	26,1	3	13,0	9	39,1
36 - 45	5	21,7	1	4,4	6	26,1
46 - 55	4	17,3	1	4,4	5	21,7
≥ 56	3	13,1	-	-	3	13,1
Total	18	78,2	5	21,8	23	100,0

As shown in table 1, the predominant age range of patients was 26-35 for both males and females, representing 39,1 % of the total number of patients.

Of the 23 patients studied, 12 of them presented motor vehicle accidents as an aetiological factor for 52,2 % of the total; it was in the middle third of the tibia where fractures occurred most frequently, with 13 representing 56,6 %

Of the total tibia fractures treated with external fixation, 19 were open or exposed to communication with the external environment, representing 82,6 % of the total (figure 1).

Regarding the type of fracture according to the AO/ASIF classification, 34,8 % were wedged (B), which means 8 patients out of the total (figure 2).

Table 2. Patients with tibial fractures treated with external fixation according to aetiology and most frequent location of tibial fractures

Aetiology	Most common fracture locations of tibia fractures							
	Upper third		Middle third		Lower third		Total	
	No.	%	No.	%	No.	%	No.	%
Assault injuries	-	-	3	13,1	1	4,3	4	17,4
Accidents at work	1	4,3	4	17,4	2	8,7	7	30,4
Motor vehicle accidents	2	8,7	6	26,1	4	17,4	12	52,2
TOTAL	3	13,0	13	56,6	7	30,4	23	100,0

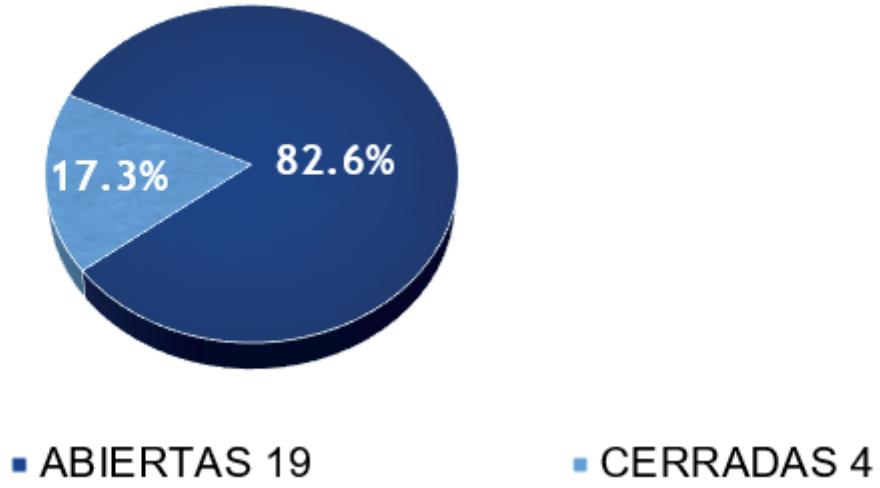

Figure 1. Distribution according to the communication of the fracture with the external environment

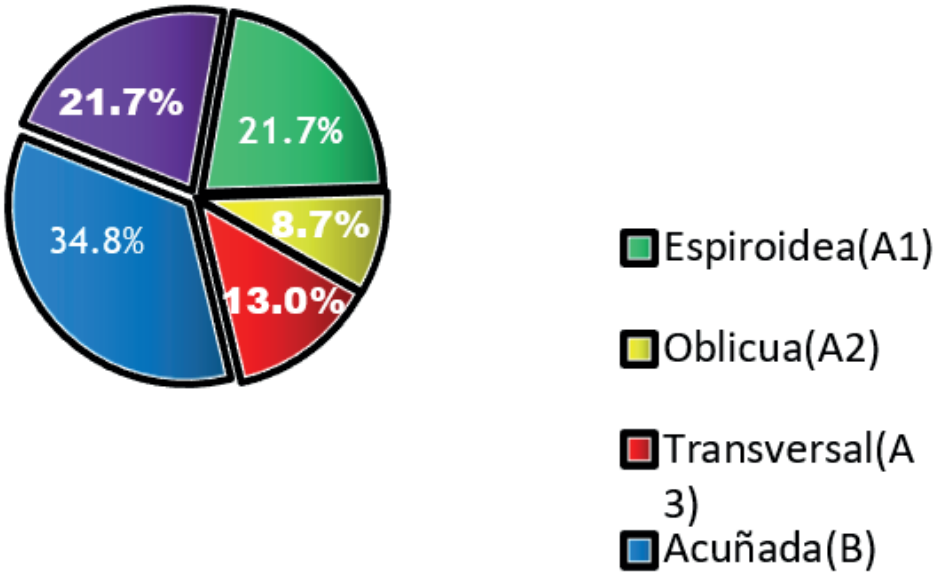

Figure 2. Distribution of patients according to fracture type by AO/ASIF classification

Table 3. Patients with tibial fractures treated with external fixation according to pain intensity.

Pain (numerical visual scale)	No.	%
No pain (0)	8	34,8
Mild pain (1-3)	10	43,5
Moderate pain (4-6)	4	17,4
Severe pain (7-10)	1	4,3
Total	23	100,0

Table 3 reveals that at 7 days after surgery, 10 patients reported mild pain, representing 43,5 % of the total, and 8 did not complain of pain, representing 34,8 % of the sample studied.

Of the patients studied, nine did not develop complications, representing 39,1 %; however, of the patients who did develop complications, the most frequent was the presence of superficial infections, with six patients representing 26,1 %. (table 4).

Table 4. Patients with tibia fractures treated with external fixation according to the most frequent complications

Complications	No.	%
No complications	9	39,1
Delayed consolidation	3	13,0
Pseudarthrosis	3	13,0
Superficial infections	6	26,1
Osteomyelitis	2	8,8
Total	23	100,0

Table 5 represents the results related to the level of work and social limitation of patients with tibia fractures treated with external fixation. Of these, 11 patients had no complaints of limitations once incorporated into work and social activities, representing 47,8 %.

Table 5. Patients with tibia fractures treated with external fixation according to the level of work and social limitation

Work and social limitation	No.	%
No complaints	11	47,8
Mild symptoms that do not interfere with activities	6	26,1
Symptoms interfere but do not impede activities	4	17,4
Symptoms radically change activities	2	8,7
Total	23	100,0

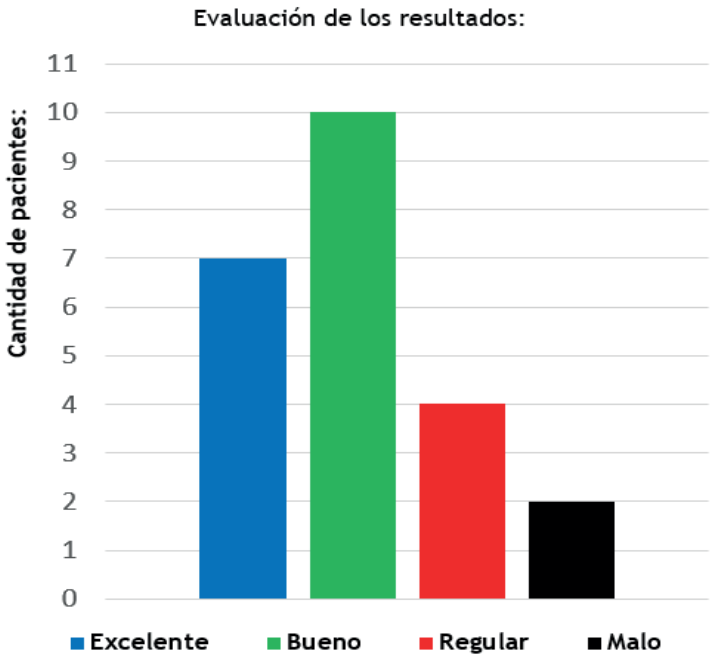

Figure 3. Patients with tibia fractures treated with external fixation according to outcome assessment

Figure 3 shows that most patients obtained satisfactory results, 7 cases with excellent evolution and 10 with good evolution, representing 73,9 % of all the cases studied.

DISCUSSION

Despite the emancipation of women in society, even today, men still carry out the jobs of strength and danger. In many cases, they are responsible for leading the household economy, so the risk of accidents increases in this sex. This study

coincides with that carried out by Valderrama CO. open fractures: treatment at the first level (Open fractures: treatment at the first level), which shows that the male sex predominates over the female sex.[11]

The preponderance of the injury in young adults between 26 and 35 years of age, with a ratio of 2:1 concerning women, is explained by their work and the cause. Likewise, the average age of the patients affected in this series was 30 years, as also reported in other publications on the subject, especially from developed nations such as the study by Waldo Saldaña JC. Epidemiological, clinical and radiological aspects of fractures of the tibia and fibula in patients over 18 years of age in the II-2 Tarapoto Hospital.; where the prevalence of the injury in young adults from 25 to 39 years of age is exposed, with a ratio of 3:1 with respect to women, explained by the work they do and the cause of the injury.[12]

What happened in this research is logical because taking into account that tibia fractures are associated with high-intensity impacts corresponds to the cases studied in this series, in which automobile accidents are the most frequent, coinciding with the study carried out by Vázquez Ribas E, Tabares Sáez H, Morales Seife R, Tabares Neyra HI—characterization of tibia fractures. Cuban Journal of Orthopaedics and Traumatology, where the most frequent mechanism of injury in the patients under study was automobile accidents, with 70 % of the cases, which is closely related to high-energy injuries.[13]

Regarding the exposure of the fractures to the external environment, it was determined that external fixation was used in the patients under study in a total of cases of exposed fractures; this is because, as mentioned in the literature, these are high-impact injuries in which the soft tissues and bone tissue are extensively compromised, and because of this, the use of this fixation was used, coinciding with studies such as Santana Edgardo. Melo A Humberto. 'External fixation in the emergency treatment of unstable fractures of the lower limbs.' Chilean Journal of Surgery, where external fixation was used more frequently in exposed fractures because, in this type of injury, there is extensive soft tissue involvement plus contamination of the affected area.[14]

Regarding the type of fracture according to the AO/ASIF classification, the following were coined (B), coinciding with Cortéz F. and Modesto C. Closed and exposed first—and second-degree diaphyseal fractures of the tibia treated with a disposable external fixator at the Sergio E. Bernales Hospital.[15]

The evaluation 7 days after surgery showed that some patients reported mild pain and others did not complain, demonstrating how the migration towards lower pain categories was necessary. This coincides with the study by Zalavras CG and Patzakis MJ, Open fractures: evaluation and management, where the highest pain perception on the scale is located in the preoperative period and the lowest in the postoperative period.[16]

There were no complications in the patients studied where the external fixator was used as a treatment, and a group that showed superficial infections as the main complication coincided with Patiño Dominguez LA. Reyes Pantoja R. "Use of external fixator in diaphyseal fractures of the tibia as definitive treatment"., where superficial infections are presented as the most frequent complication with 46 % of the cases.[17]

Beltsios M, Stavlas P, Koukos K, Vasiliadis E, Polyzois B, Koinis A: External fixation as a definite treatment for tibial shaft fractures. Thriasio General Hospital, Orthopaedic Department, Athens, Greece, where patients in whom external fixation was used as treatment, 61 % did not present any complication, and 22 % presented infection as the main complication.[18]

About the behavior in their work and social activities, once they had returned to these, 47,8 % of the patients presented no complaints, coinciding with the findings of Bone L, Stegemann P, McNamara K, Seibel R: External fixation of severely comminuted and open tibial fractures, Clin Orthop R R. in their study, which shows that 54 % re-established their daily activities without the presence of limitations.[19]

Regarding the results, the majority of patients obtained satisfactory results, ranging from excellent to good evolution, coinciding with the following: Baumeister S, Levin LS, Erdmann D. Literature and own strategies concerning soft-tissue reconstruction and exposed osteosynthetic hardware, where they assume that the use of external fixators in these complex fractures, articular or not, facilitated a good evolution of the fracture.[20]

Bone L, Stegemann P, McNamara K, Seibel R: External fixation of severely comminuted and open tibial fractures. Clin Orthop R R considers external fixation a valuable and practical method for treating this type of fracture and presents reproducible results from what has been reported in the literature.[19]

CONCLUSIONS

It is concluded that external fixation remains an appropriate treatment option in managing tibial fractures, as satisfactory results were obtained in most of the patients studied.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualisation: Emmanuel González, Guillermo Reyes, Lázaro Leduan, Mario Mesa and Guillermo Breijo.
Formal analysis: Emmanuel González, Lázaro Leduan and Guillermo Reyes.
Research: Emmanuel González, Mario Mesa and Guillermo Breijo.
Methodology: Lázaro Leduan and Guillermo Reyes.
Project management: Emmanuel González and Lázaro Leduan.
Supervision: Mario Mesa and Guillermo Breijo.
Validation: Emmanuel González and Lázaro Leduan.
Visualisation: Emmanuel González, Guillermo Reyes.
Writing - original draft: Lázaro Leduan and Emmanuel González, Guillermo Reyes.
Writing - revision and editing: Lázaro Leduan and Mario Mesa, Guillermo Breijo.