

**Surgical treatment of ankle fractures and removal of plates/screws:  
descriptive study on health care financing in Belo Horizonte, Minas  
Gerais, Brazil, 2014-2019**

**Tratamento cirúrgico de fratura do tornozelo e retirada de  
placas/parafuso: estudo descritivo sobre o financiamento em Belo  
Horizonte, Minas Gerais, Brasil, 2014–2019**

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**ABSTRACT**

Objective: to describe hospitalizations and hospital costs for surgical treatment of unimalleolar ankle fractures, by surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture and by removing the plate and/or screws, in the period from 2014 to 2019, in the city of Belo Horizonte, Minas Gerais. Methods: Retrospective descriptive study carried out between 2014 and 2019 with epidemiological data obtained

in the database of the Department of Informatics of the Unified Health System, from the registration of the Hospitalization Authorization and the values, total and for hospital services, spent with the treatment. surgical fracture of the unimalleolar ankle; surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture; and the plate and/or screw removal procedure. Results: Between 2014 and 2019, 13,721 surgical procedures were recorded in the ankle region, with R\$ 7,889,737.75 being spent on invasive interventions. Conclusion: from the results of this research, it is suggested the need to reinforce public policies aimed at the implementation of concrete actions to seek better efficiency in the process of selecting materials, reviewing clinical and surgical protocols.

**Keywords:** Ankle Fractures, Internal Fracture Fixation, Ankle Injuries, Health Care Financing, Orthopedics.

## RESUMO

Objetivo: descrever as internações e os custos hospitalares por tratamento cirúrgico de fratura do tornozelo unimaleolar; por tratamento cirúrgico de fratura do tornozelo bimalleolar, trimaleolar, da fratura luxação do tornozelo; e por retirada de placa e/ou parafusos, no período de 2014 a 2019, no município de Belo Horizonte, Minas Gerais. Métodos: Estudo retrospectivo descritivo realizado entre 2014 a 2019 com dados epidemiológicos obtidos no banco de dados do Departamento de Informática do Sistema Único de Saúde, oriundos do cadastro da Autorização de Internação Hospitalar e dos valores, total e por serviços hospitalares, despendidos com o tratamento cirúrgico de fratura do tornozelo unimaleolar; o tratamento cirúrgico de fratura do tornozelo bimalleolar, trimaleolar, da fratura de luxação do tornozelo; e o procedimento de retirada de placa e/ou parafusos. Resultados: Entre 2014 a 2019 foram registrados 13.721 procedimentos cirúrgicos em região de tornozelo, sendo gastos R\$ 7.889.737,75 com as intervenções invasivas. Conclusão: sugere-se a partir dos resultados desta pesquisa a necessidade de reforçar políticas públicas voltadas para a implementação de ações concretas, para à busca de melhor eficácia no processo de seleção de materiais, revisão de protocolos clínicos e cirúrgicos.

**Palavra-Chave:** Fraturas do Tornozelo, Fixação Interna de Fraturas, Traumatismos do Tornozelo, Financiamento da Assistência à Saúde, Ortopedia.

## 1 INTRODUCTION

Ankle fracture is one of the most common fractures in orthopedic traumatology, reaching an incidence of 174 fractures per 100,000 adults - year<sup>1,2</sup>. It is estimated that the number of cases will be even greater with the aging of the population, which makes the treatment of this condition very important, both from an orthopedic and an economic point of view<sup>1,3,4</sup>.

In the national scenario, we observe that automobile accidents, especially those related to motorcycles, are the ones that lead to more potential damage in the ankle region since the high energy involved in this type of trauma provides increasingly complex

fracture patterns<sup>5, 6</sup>.

When observing worldwide, trauma reaches similar incidence as a pandemic with 5.8 million deaths a year, considered one of the five most important causes of morbidity in individuals under 60 years old<sup>7</sup> and the eighth cause according to PAHO/WHO (2018)<sup>8</sup>.

In the United States of America, trauma has become one of the main causes of disability and death, especially in children and young adults, under the age of 45, in which trauma is responsible for 79,000 annual deaths. This total is above deaths from non-communicable diseases (49,000) and infectious diseases (15,000)<sup>9</sup>.

Due to the greater accuracy of the imaging exams currently available, there is a higher frequency of lesions that affect tibiofibular syndesmosis<sup>10</sup>. In this sense, the treatment of this lesion can currently be carried out by various means, such as endobutton and graft reconstruction<sup>10,11</sup>. However, the use of inter-tibiofibular screws is currently the most popular technique among orthopedic surgeons, whether due to the wide availability of material or the lesser technical requirement<sup>10-12</sup>.

Although common, the use of inter-tibiofibular screws has an important drawback, which is the need for a second surgical act for its removal since the device is a rigid intra-articular fixation in the interosseous membrane, increasing the expenses with the financing of the health care in the orthopedic procedures and, therefore, the risk for the patient<sup>13</sup>.

In this sense, it is important to evaluate the economic impact that the procedure of removing the inter-tibiofibular screw, so we can compare more clearly the use of this method with others that do not require a second surgery, establishing a better cost strategy for the health systems and allowing the design of other strategies that are less costly and more effective for patients, such as the use of materials that do not require their removal.

This study aims to describe hospitalizations and hospital costs for surgical treatment of unimalleolar ankle fractures, by surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture and by removing the plate and/or screws, in the period from 2014 to 2019, in the city of Belo Horizonte, Minas Gerais.

## 2 MATERIALS AND METHODS

This is a retrospective descriptive study carried out between 2014 to 2019 with epidemiological data obtained in the database of the Department of Informatics of the Unified Health System (DATASUS)<sup>14</sup>, from the “Authorization for Hospitalization” (AIH) form, a document filled out by the responsible physician at the time hospitalization

and data on total values and hospital services spent on surgical treatment of unimalleolar ankle fractures (code 0408050578); surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture (code 0408050497); and the procedure for removing the plate and/or screws (code 0408060379).

We included data on patients older than 18 years old, whose primary diagnosis of hospitalization includes the mentioned codes. Population estimates were obtained from demographic censuses by the Brazilian Institute of Geography and Statistics (IBGE).

Considering that the referred study was based on a public domain database, without identification data, the study was exempted from appreciation by the Ethics and Research Committee as provided in resolution number 466 of the National Council for Ethics in Research<sup>15</sup>.

### 3 RESULTS

According to data extracted from DATASUS<sup>14</sup>, 49,262 procedures were recorded with codes 0408050578, 0408050497, 0408060379 from 2014 to 2019, with 14,657 surgical procedures for the treatment of unimalleolar ankle fractures; 17,315 surgeries to treat bimalleolar, trimalleolar ankle fractures, ankle dislocation fractures; and 17,290 for removing plate and/or screws throughout the state of Minas Gerais.

Considering only the municipality of Belo Horizonte, in the same period, the number of surgeries to treat unimalleolar ankle fractures was 4,137 procedures; considering the surgical treatment for the treatment of bimalleolar, trimalleolar ankle fractures, ankle dislocation fractures, there were 3,967 procedures; and 5,617 records were detected in DATASUS referring to the procedure for removing plaque and/or screws, making a total of 13,721 ankle-related procedures performed in hospital institutions linked to the Unified Health System (SUS). Table 1 shows the distribution per year.

Table 1 – Number of procedures registered in DATASUS using the procedure code contained in Authorization for Hospitalization (AIH) in Belo Horizonte, MG, from 2014 to 2019.

Procedure registered with the AIH	2014		2015		2016		2017		2018		2019	
	n	%	n	%	n	%	n	%	n	%	n	%
Surgical treatment of unimalleolar ankle fracture	677	33.7	709	31.9	703	28.3	741	31.1	687	29.5	583	26.8

Surgical treatment of unimalleolar ankle fracture	609	30.4	571	25.7	677	27.3	641	26.9	731	31.4	683	31.4
Surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture	720	35.9	944	42.4	1102	44.4	999	42.0	910	39.1	906	41.7
Plate and/or screw removal procedure												
<b>Total</b>	<b>2006</b>	<b>100</b>	<b>2224</b>	<b>100</b>	<b>2482</b>	<b>100</b>	<b>2381</b>	<b>100</b>	<b>2328</b>	<b>100</b>	<b>2172</b>	<b>100</b>

Source: DATASUS

Table 2 shows the total amount in Reais Brazilian currency of hospital expenses for surgical treatment of unimalleolar ankle fracture, by surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture, and the plate and/or screw removal procedure, between 2014 and 2019.

Table 2 – Total amount spent with surgical treatment of unimalleolar ankle fracture, by surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture, and the plate and/or screw removal procedure in Belo Horizonte - MG, between 2014 and 2019.

Procedur e registered with the AIH	2014	2015	2016	2017	2018	2019
	R\$	R\$	R\$	R\$	R\$	R\$
Surgical treatment of unimalleolar ankle fracture	503,550.03	517,769.61	522,949.80	551,967.82	491,621.51	427,987.93
Surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture	474,461.68	455,381.23	561,306.01	535,204.04	593,167.96	574,629.91
Plate and/or screw removal procedure	248,790.32	310,933.33	370,033.65	260,274.23	247,080.80	242,627.89
<b>Total</b>	<b>1,226,802.03</b>	<b>1,284,084.17</b>	<b>1,454,289.46</b>	<b>1,347,446.09</b>	<b>1,331,870.27</b>	<b>1,245,245.73</b>

Source: DATASUS

We noticed that there was an expense of R\$ 7,889,737.75 in the total amount spent with the procedures under study. In the amounts spent on hospital services, we noted that there is no considerable decrease, using an amount of R\$ 6,015,636.58, as shown in table 3. In this sense, it is evident that the amount of R\$ 1,860 .852.47 was used to finance professional services.

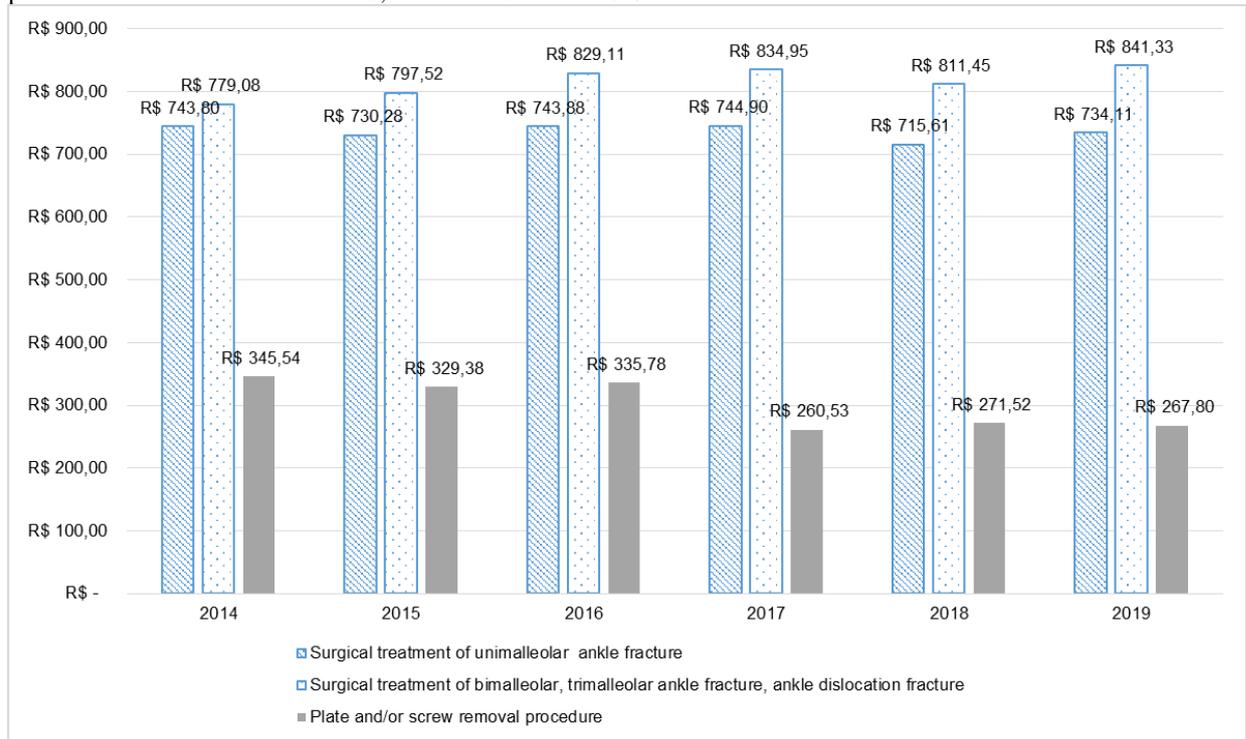
Table 3 – Values spent on hospital services for the surgical treatment of unimalleolar ankle fractures, surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture, and with the plate and/or screw removal procedure in Belo Horizonte - MG, between 2014 and 2019.

Procedure registered with the AIH	2014	2015	2016	2017	2018	2019
	R\$	R\$	R\$	R\$	R\$	R\$
Surgical treatment of unimalleolar ankle fracture	400,112.65	412,454.58	416,642.63	439,937.68	391,452.71	340,453.61
Surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture	343,867.02	332,927.77	415,137.06	398,170.62	444,336.87	432,300.71
Plate and/or screw removal procedure	190,648.60	226,620.10	271,594.73	192,603.29	185,376.87	180,999.08
<b>Total</b>	<b>934,628.27</b>	<b>972,002.45</b>	<b>1,103,374.42</b>	<b>1,030,711.59</b>	<b>1,021,166.45</b>	<b>953,753.40</b>

Source: DATASUS

The average amount per AIH and hospitalization from 2014 to 2019 was the equivalent of R\$ 619.90 as shown in graph 1.

Graph 1 - Distribution of the average amount (R\$, Reais Brazilian currency) spent on hospitalization according to AIH emission for the surgical treatment of unimalleolar ankle fractures, surgical treatment of bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture, and with the plate and/or screw removal procedure in Belo Horizonte - MG, between 2014 and 2019.



Source: DATASUS

### 3 DISCUSSION

Considering the data from DATASUS<sup>14</sup>, only in 2019, 47,498 surgeries were performed in the country for surgical treatment of ankle fractures in the Unified Health System (SUS), totaling an expense of over 36 million Reais<sup>16</sup>.

In Brazil, two factors favor the increase in the number of patients undergoing surgical treatment of fractures or fractures-dislocations of the ankle, the increase in the number of high-energy car accidents, and the aging of the population<sup>17-19</sup>. In this context, evaluating strategies to correct ankle injuries that favor quality of life in the post-surgical period, and the use of measures that try to combat the process of decreasing bone mineral density are necessary<sup>18,19</sup>.

The analysis of strategies with a better relationship between cost and effectiveness in the treatment of ankle injuries is fundamental not only for a better recovery of patients but also for the financial viability of health systems<sup>20</sup>.

Studies show that the costs related to different methods of treating ankle injuries are very divergent, with national studies still scarce<sup>16-20</sup>. Ankle fractures demand a large expenditure of public resources for their treatment due to their high prevalence and frequent need for surgical interventions<sup>19</sup>. A study carried out in Finland showed that the

use of specific surgical materials for the treatment of ankle fractures substantially reduced the hospital costs of extra removals, with a particular reduction in plaque removal surgeries<sup>20</sup>.

We observed that most of the total expenses presented are due to the costs of hospitalization, a counterpoint with a lower amount spent on paying professionals. In the same way, there is a lack of studies that show a correlation between variables concerning surgical treatment of ankle fractures. Research that analyzed the temporal trend of surgical admissions by the Unified Health System (SUS), exposes that, for musculoskeletal surgeries, there was a constant trend between surgical admissions and the subgroup of procedures<sup>21</sup>. The time trend of the average hospital stay according to the subgroup of surgical procedures increased from 2008 to 2016<sup>21</sup>.

Considering a study carried out in the city of Uberlândia, Minas Gerais, MG, Brazil, the total expenses spent on surgeries performed at a federal university hospital, is directly related to the number of procedures and their complexity such as the general surgery specialties, orthopedics, and traumatology<sup>22</sup>.

We highlight the questioning that despite the screws generally used in syndesmosis lesions being the material with the greatest availability and the lowest cost, hospitalization associated with the new surgical procedure for the removal of this material burdens the public financing systems health and exposes the patient to risks inherent to the procedure.

The evaluation of new strategies such as the use of suture buttons for the treatment of syndesmosis lesions, although more expensive at first, should be better studied and evaluated both for the best clinical and financial results<sup>23,24</sup>. The suture end button offers potential advantages, including more anatomical mobility of the joint, faster return to weight support, and without the need to remove the implant<sup>24</sup>.

The use of devices such as suture buttons still not very popular due to the high cost and lack of familiarity of surgeons is a relevant option in the current scenario since recent studies show satisfactory clinical results and without the need for its removal in a second moment<sup>24-26</sup>.

#### 4 CONCLUSION

This study revealed that, according to the TABNET/DATASUS data, Belo Horizonte corresponds to the highest proportion of procedures performed in the surgical treatment of unimalleolar ankle fractures (code 0408050578); surgical treatment of

bimalleolar, trimalleolar ankle fracture, ankle dislocation fracture (code 0408050497); and the plate and/or screw removal procedure (code 0408060379), from 2014 to 2019.

We can reflect that the expenses related to the procedures can be minimized, according to national and international literature, with the possibility of replacing orthopedic surgical material.

There is an urgent need for new public policies to consider implementing concrete actions, aimed at seeking maximum effectiveness in the process of selecting materials and reviewing clinical and surgical protocols, reflecting on the quality of life for the patient and optimization of funding. Another essential way forward is the development of new works, research, and extensions, with the aforementioned theme.

## REFERENCES

1. Cogan C, Liu T, Toogood P. An Assessment of Normal Tibiofibular Anatomy on Lateral Fluoroscopy. *Foot Ankle Int.* 2020;41(7):866-869. doi:10.1177/1071100720917639
2. Debieux P, Wajnsztein A, Mansur NSB. ARTIGO ORIGINAL Epidemiologia das lesões por entorse do tornozelo diagnosticadas em pronto atendimento de ortopedia. *Inst Isr Ensino e Pesqui Albert Einstein.* 2019;17(4):1-5. doi:10.31744/einstein
3. Volgas D, DeVries JG, Stannard JP. Short-term financial outcomes of pilon fractures. *J foot ankle Surg Off Publ Am Coll Foot Ankle Surg.* 2010;49(1):47-51. doi:10.1053/j.jfas.2009.07.017
4. Smeets B, Nijs S, Nderlita M, Vandoren C, Hoekstra H. Health Care Usage and Related Costs in Fibular Plating for AO Type 44-B Ankle Fractures in a Belgian University Hospital: An Exploratory Analysis. *J foot ankle Surg Off Publ Am Coll Foot Ankle Surg.* 2016;55(3):535-541. doi:10.1053/j.jfas.2016.02.004
5. Bittar CK, Júnior AC, da Costa VSDA, de Freitas Pacheco AC, Ricci RL. Epidemiological profile of motorcycle accident victims in university hospital. *Acta Ortop Bras.* 2020;28(2):97-99. doi:10.1590/1413-785220202802230035
6. Bittar CK, Cliquet Junior A, da Costa VSDA, Pacheco AC de F, Ricci RL. Socioeconomic impact of motorcycle accident victims in the emergency room of a hospital (part 2). *Acta Ortop Bras.* 2020;28(3):149-151. doi:10.1590/1413-785220202803230036
7. Păun S, Beuran M, Negoii I, Runcanu A, Gaspar B. [Trauma--epidemiology: where are we today?]. *Chirurgia (Bucur).* 2011;106(4):439-443.
8. Organização Pan-Americana de Saúde OM de S. 10 principais causas de morte no mundo: OPAS/OMS 2018. Published 2018. Accessed November 30, 2020. [https://www.paho.org/bra/index.php?option=com\\_content&view=article&id=5638:10-principais-causas-de-morte-no-mundo&Itemid=0](https://www.paho.org/bra/index.php?option=com_content&view=article&id=5638:10-principais-causas-de-morte-no-mundo&Itemid=0)
9. Maggio C, Chee P, Shinseki M, et al. Traumatic Injury in the US. *Injury.* 2016;176(1):139-148. doi:10.1016/j.injury.2016.04.002.Traumatic
10. Tourné Y, Molinier F, Andrieu M, Porta J, Barbier G. Diagnosis and treatment of tibiofibular syndesmosis lesions. *Orthop Traumatol Surg Res.* 2019;105(8S):S275-S286. doi:10.1016/j.otsr.2019.09.014
11. Huang H, Yang Y. [Research progress in diagnosis and treatment of distal tibiofibular syndesmosis injury]. *Zhongguo xiu fu chong jian wai ke za zhi = Zhongguo xiu fu chong jian wai ke zazhi = Chinese J reparative Reconstr Surg.* 2020;34(10):1346-1351. doi:10.7507/1002-1892.201911090
12. Song L, Liao Z, Kuang Z, et al. Comparison of tendon suture fixation and cortical screw fixation for treatment of distal tibiofibular syndesmosis injury: A case-control study. *Medicine (Baltimore).* 2020;99(34):e21573. doi:10.1097/MD.00000000000021573
13. Chilmi MZ, Desnantyo AT, Widhiyanto L, Wirashada BC. Low tibial and fibular osteotomy for treating varus-type post-traumatic ankle osteoarthritis: A case report.

Malaysian Orthop J. 2020;14(2):145-148. doi:10.5704/MOJ.2007.025

14. Brasil. Datasus: informações de saúde. Published 2020. Accessed November 30, 2020. <https://datasus.saude.gov.br/informacoes-de-saude-tabnet/>

15. Brasil. Resolução nº 466, de 12 de dezembro de 2012. Cons Nac Ética em Pesqui. 2012;DOU nº 12,;01-12. <https://conselho.saude.gov.br/resolucoes/2012/Reso466.pdf>

16. Goost H, Wimmer MD, Barg A, Kabir K, Valderrabano V, Burger C. Frakturen des oberen Sprunggelenkes: Diagnostik und Therapieoptionen. Dtsch Arztebl Int. 2014;111(21):377-388. doi:10.3238/arztebl.2014.0377

17. Scheer RC, Newman JM, Zhou JJ, et al. Ankle Fracture Epidemiology in the United States: Patient-Related Trends and Mechanisms of Injury. J foot ankle Surg Off Publ Am Coll Foot Ankle Surg. 2020;59(3):479-483. doi:10.1053/j.fas.2019.09.016

18. Silva ARB, Martinez LC, Pinheiro MM, Szejnfeld VL. Low-trauma ankle fractures in Brazil: secular trends in patients over 50 years old from 2004 to 2013. Arch Osteoporos. 2020;15(1). doi:10.1007/s11657-020-00777-6

19. Rasmussen CG, Jørgensen SB, Larsen P, Horodyskyy M, Kjær IL, Elsoe R. Population-based incidence and epidemiology of 5912 foot fractures. Foot ankle Surg Off J Eur Soc Foot Ankle Surg. Published online May 2020. doi:10.1016/j.fas.2020.03.009

20. Partio N, Huttunen TT, Mäenpää HM, Mattila VM. Reduced incidence and economic cost of hardware removal after ankle fracture surgery: a 20-year nationwide registry study. Acta Orthop. 2020;91(3):331-335. doi:10.1080/17453674.2020.1733749

21. Covre ER, Melo WA de, Tostes MF do P, Fernandes CAM. Permanence, cost and mortality related to surgical admissions by the Unified Health System. Rev Lat Am Enfermagem. 2019;27. doi:10.1590/1518-8345.2618-3136

22. Sousa AFM de. Custos cirúrgicos versus repasse do SUS: conhecendo a realidade do hospital de clínicas da Universidade Federal de Uberlândia. Published online 2019. doi:<http://dx.doi.org/10.14393/ufu.di.2019.2194>

23. Michelson JD, Wright M, Blankstein M. Syndesmotic Ankle Fractures. J Orthop Trauma. 2018;32(1):10-14. doi:10.1097/BOT.0000000000000937

24. Shafiq B, Thamyongkit S. Bimalleolar Ankle Fracture With Syndesmotic Sprain: ORIF and Suture-Endobutton Repair. J Orthop Trauma. 2019;33 Suppl 1:S36-S37. doi:10.1097/BOT.0000000000001538

25. Kapadia BH, Sabarese MJ, Chatterjee D, et al. Evaluating success rate and comparing complications of operative techniques used to treat chronic syndesmosis injuries. J Orthop. 2020;22(March):225-230. doi:10.1016/j.jor.2020.04.011

26. Wang W, Fan Y, Liu C, et al. [Short-term effectiveness of Endobutton plate in reconstruction of Lisfranc ligament]. Zhongguo xiu fu chong jian wai ke za zhi = Zhongguo xiu fu chongjian waike zazhi = Chinese J reparative Reconstr Surg. 2020;34(11):1382-1386. doi:10.7507/1002-1892.202005034