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Mohammad Almalki
College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Ibrahim Al-Tawayjri
College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Nawaf Alamri
College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Amjaad Almohawis
College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Shaker Al Shehri
Department of Surgery, division of Orthopedics, King Abdulaziz Medical City, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Nader Alkenani
Department of Surgery, division of Orthopedics, King Abdulaziz Medical City, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Correspondence
Nawaf Alamri
College of Medicine, King Saud Bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Al Hars Al Watani, Ar Rimayah, 14611

Indications and postoperative complications of tibial Illizarov's technique in a tertiary care center, Saudi Arabia

Mohammad Almalki, Ibrahim Al-Tawayjri, Nawaf Alamri, Amjaad Almohawis, Shaker Al Shehri and Nader Alkenani

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Abstract
Background: Circular external fixation including Ilizarov method is a well-established technique often practiced in orthopedic surgery. The goal of this procedures is to lengthen extremity bones, reconstruct severely injured or fractured bone trauma, correct congenital bone deformities, treat infected bones and to treat pseudarthrosis. The importance of this study is that it will highlight the most common complications for this procedure in order to reverse them and have a better clinical outcome. The aim of this study is to assess the indications and postoperative complication rates following tibial circular external by Illizarov's method.
Methods: We performed a consecutive case series, chart review study of 33 patients who were treated with the Ilizarov method, between 2010 and 2016. All patients who underwent tibial circular external fixators using Ilizarov method were selected for this study. There were 25 males and 8 females, mean age was 31.06 (range 14 -71). All data collected was coded in Excel sheet. SPSS package version 20 was used for data analysis.
Results: The total number of subjects involved in this study was 33 subjects (Male: 25[75%]-Female: 8[25%]). The average age of the subjects was 31.06 (range 14 -71) with a standard deviation of +/-13.8. Overall, 63.6% of patients reported post-op complications. Whereas 36.3% of patients were free of complications. The main complication was pain which was reported in 15% of the subjects.
Conclusion: There was a minimal complication rate associated with this technique in our institution compared to published studies. Several medical conditions were the indication for this procedure, primarily motor vehicle accidents deformities.

Keywords: Indication, Complication, External, Circular, Fixation, Tibia, Illizarov

1. Introduction
Circular external fixation including Ilizarov method is a well-established technique often practiced in orthopedic surgery. The goal of this procedures is to lengthen extremity bones, reconstruct severely injured or fractured bone trauma, correct congenital bone deformities, treat infected bones and to treat pseudarthrosis, a condition where the fractured bones do not unite or form a false joint [1]. The external circular fixators are composed of three circular fixators made of titanium, vertical rods and a stainless steel pins (also called K-wires) [2].
The mechanism of this procedure is to fixate the healthy bones with the K-wires being attached to upper and lower rings bypassing the middle ring which in addition to its K-wires functions as a fracture stabilizer and to hold the fracture's bony fragments [3]. The concept of the vertical rods that are linked between the upper and lower rings through the middle ring is to bypass the mechanical force applied by the patient's weight on the fracture site making it immobile and giving it a relief of stress and a more chance to reunite the fractured bone [4]. The external circular fixators are often used as a solution for many conditions in the treatment of tibial bone complicated fractures. A study by Ajmera *et al*. proved that the reconstruction system for treating tibial open fractures using Illizarov method is an effective modality [5]. It is a simple surgical technique which is a minimal invasive surgery that has a high patient compliance, easy wound management, lesser hospitalization. External circular fixators have a number of indications like: infection, tibial psudoarthrosis, correction of congenital

psudoarthrosis [6], tibial osteomyelitis, post traumatic deformities, rickets related deformities, and stature or extremity lengthening [7] and different deformities [8].

External circular fixators have a number of complications: In a study in 1997 by Marsh *et al*. showed a complication rate of malunion (29%), nonunion (42%), pin track infections (53%) [9]. Another study by Adair *et al*. in 2003 showed a complications of neurovascular problems (4%), pain (4%), psychological problems (0.3%) [10]. Moreover, a study by Vargas *et al*. in 2007 showed a complications of premature or delayed consolidation (14%), refracture, swelling of the limb and limb length inequality [7], osteoporosis and angular deformity are common complication too. In a study by Umer *et al*. found that illizarov reconstruction can correct angular deformity and simultaneously restores the alignment of the knee and can lower-extremity length discrepancy but treatment sometimes fail to reach normal leg length discrepancy [11]. In a study published in 1990 by Paley *et al*. found that patients will suffer from difficulty sleeping, contractures of the muscle and the soft tissues, subluxation and dislocation of the adjacent joints [12]. Moreover, a study published in 1993 by Velazquez *et al*. found that paresthesia is a complication of Illizarov technique as well [13].

Plain X-rays and ultrasonography are often used to accurately measure the distraction gap and to check the consolidation of the bone [14]. The importance of this study is that it will highlight the most common complications for this procedure in order to reverse them and have a better clinical outcome. The aim of this study is to assess the indications and postoperative complication rates following tibial circular external by Illizarov's method.

2. Methods

We performed a consecutive case series, chart review study of 33 patients who were treated with the Ilizarov method by a single surgeon between 2010 and 2016. All patients who underwent tibial circular external fixators using Ilizarov method were selected for this study. There were 25 males and 8 females, mean age was 31.06 (range 14 -71). Ethical approval from the institutional review board (IRB) was obtained.

Ilizarov method was applied for 43 limbs. Complicated fractures post MVA in 14 limbs, congenital deformities and rickets related deformities in 9 limbs, lengthening and leg length discrepancy in 7 limbs, non-union fracture in 4 limbs, reconstruction of severe fracture after falling down from height in 4 limbs, osteomyelitis in 2 limbs, open fracture and infection in 2 limbs, and angular deformities in 1 limb, with some patients suffering more than one indication.

A data collection form was used to extract the data from the charts which includes: indication of the procedure and all different types of complications. In addition, the data collection also includes some demographic data such as age, gender and nationality. All data collected was coded in Excel sheet. SPSS package version 20 was used for data analysis. In this study only descriptive statistics were used to describe the rate of different types of complications.

Chi-square, and Spearman's correlation test were used to assess the the number of indications and the number of post-op complications, and the relationship between the number of indications and the number of post-op complications, a value of $P < 0.05$ was considered to be statistically significant. All collected data are categorical and were presented in terms of frequencies and percentages. To maintain the Freedom of Information and Protection of Privacy (FOIPP) Act, names were avoided on all documents, forms, and statistical analyses.

3. Results

The total number of subjects involved in this study was 33 subjects (Male: 25[75%]-Female: 8[25%]). The average age of the subjects was 31.06 (range 14 -71) with a standard deviation of +/-13.8. This study included every patient who underwent tibial circular external fixators using Ilizarov method in the period from 2010 until 2016.

The indications for the procedure were complicated fractures post MVA (32.5%), Congenital deformities and rickets related deformities (20.9%), Lengthening and leg length discrepancy (16.2%), Nonunion fracture (9.3%), Reconstruction of severe fracture after falling down from height (9.3%), Osteomyelitis (4.6%), Open fracture and infection (4.6%), and Angular deformities (2.3%) Table 1. Several patients met more than one indication, patients who met two indications (4.6%), met three indications (4.6%).

Overall, 63.6% of patients reported post-op complications. Whereas 36.3% of patients were free of complications. The most common complication that was observed was Pain (15%), followed by Infected pin site or Osteomyelitis (12.12%), Malunion (12.12%), Difficulty sleeping and psychiatric agitation (9.1%), Angular deformity (9.1%), Failure to lengthen the limb (6.06%), Swelling of the limb (6.06%), Neurovascular injury (6.06%), Leg length discrepancy (6.06%), Bleeding (6.06%), Re-fracture (3.03%), Paresthesia (3.03%), Decreased Range of motion (3.03%), and MCL laxity (3.03%) Table 2. Several patients suffered multiple post-op complications 24.24% of the patients suffered two complications, 6% suffered three complications.

Using chi-square test an association between the number of indications and the number of post-op complications was found ($p = 0.024$). A Spearman's correlation was used to assess the relationship between the number of indications and the number of post-op complications. There was a statistically significant and strong positive correlation (Spearman Correlation = 0.058, $p = .005$).

Table 1: list of procedure's indications.

Indication for surgery	N*	%
Complicated fractures post MVA	14	32.5
Congenital deformities and rickets related deformities	9	20.9
Lengthening and leg length discrepancy	7	16.2
Nonunion fracture	4	9.3
Reconstruction of severe fracture after falling down from height	4	9.3
Osteomyelitis	2	4.6
Open fracture and infection	2	4.6
Angular deformities	1	2.3
Total	43	100

N= number of patient who met the indications, * some patients suffered more than one indication.

Table 2: A list of procedure's complications.

	N*	%
Pain	**5**	**15.15**
Malunion	4	12.12
Infected pin site or Osteomyelitis	4	12.12
Difficulty sleeping and psychiatric agitation	3	9.1
Angular deformity	3	9.1
Neurovascular injury	2	6.06
Failure to lengthen the limb	2	6.06
Swelling of the limb	2	6.06
Bleeding	2	6.06
Leg length discrepancy	2	6.06
Paresthesia	1	3.03
MCL laxity	1	3.03
Re-fracture	1	3.03
Decreased range of motion	1	3.03
Total	33	100

N= number of patient who suffered the complications, * some patients suffered more than one complication.

4. Discussion

Ilizarov's method is a well-established technique often practiced in orthopedic surgery for bone reconstruction [15]. The importance of this study is that it highlights the most common complications for this procedure in order to reverse them and have a better clinical outcome. The aim of this study is to assess the indications and postoperative complication rates following tibial circular external by Illizarov's method.

The Ilizarov procedure has been used to treat severe limb length discrepancy and short stature. The lengthening method with the Ilizarov device is particularly interesting for tibial lengthening because patients continue ambulation [16].

The most common indications for the Ilizarov procedure in 33 patients were 14 patients with complicated fractures post MVA, followed by 9 patients with congenital deformities and rickets related deformities, 7 patients with lengthening and leg length discrepancy, 4 patients with nonunion fracture, 4 patients with reconstruction of severe fracture after falling down from height, 2 patients with Osteomyelitis, 2 patients with open fracture and infection and finally, 1 patient with angular deformities. Several patients met more than one indication.

The sample is relatively young in age (average of 31 years old), this is going in parallel to the huge youth population in Saudi Arabia [17]. However, The pediatric subjects were very little in our institution because of few experienced surgeons in this method in our institution and in Saudi Arabia in general. The most common indication for this procedure was motor vehicle accidents (MVA) deformities, the female subjects were less than the male subjects possibly due to the fact that females don't drive in Saudi Arabia and are less prone to MVAs as reported by previous studies in Saudi Arabia [18].

Motor vehicle accidents deformities were the most common indication for Illizarov's method in our study; this is attributed to the high impact of MVAs in our community. In a study by Aldawood AS *et al*. MVAs was the most common cause of injury (78.4%) in trauma cases admitted to the ICU in largest trauma center in Saudi Arabia [19].

The second most common indication for Illizarov's method in our study was patients with congenital deformities and rickets related deformities, similar indication were reported in the literature by Petje G *et al*. where he We performed 37 corrective operations in 10 children and followed them up [20].

Leg length discrepancy or short stature were the third most common indication for Illizarov's method in our institution, it is a very common indication for this procedure, similar literature reported the same indication by Caton J *et al*. between 1984 and 2001, where he performed lengthening surgeries to 57 patients by Ilizarov's method [21].

Similar indications in this study were found In a study in 1997 by Marsh *et al*. were he reviewed a series of 56 consecutive patients treated by the Ilizarov circular fixator for various indications that includes nonunion, malunion and infection of fractures [9]. Moreover, there was a study by Vidyadhara and K. Rao *et al*. where they treated 21 consecutive patients between 1998 and 2002 with complex tibial pilon fractures using percutaneous reduction and fixation with the small diameter Ilizarov apparatus as in this study [22].

We reported no case in the treatment of pseudoarthrosis, although it was reported in the literature in several studies. In 2012, a study by Agashe, *et al*, reviewed 15 cases of congenital pseudoarthrosis of the tibia (CPT) that were treated with a combination of Ilizarov's apparatus between 2003 and 2008 [6].

Regarding the complications in our study, the most common complication was Pain in 5 patients, followed by 4 patients with Infected pin site or osteomyelitis, 4 patients with malunion, 3 patients with difficulty sleeping and psychiatric agitation, 3 patients with angular deformity, 2 patients with failure to lengthen the limb, 2 patients with swelling of the limb, 2 patients with neurovascular injury, 2 patients with leg length discrepancy,2 patients with bleeding, re-fracture, 1 patient with paresthesia, 1 patient with decreased range of motion, and 1 patient with MCL laxity. Several patients suffered multiple post-op complications.

Overall, 63.6% of patients reported post-op complications. Whereas 36.3% of patients were free of complications. The most common complication was pain in 5 patients (15%) which is considered relatively compared to the literature. A study by Moraal J *et al*. reported pain from 21 subjects out of 37 subjects (56%) [23].

The second most common complication in our study is infected pin site or osteomyelitis in 4 patients (12%) which is considered relatively low as well compared to the reported literature. In 1997 a study by Marsh *et al*. showed 138 episodes of pin- or wire track sepsis in 49 patients, 36 of which required treatment in hospital. The other 102 episodes were managed on an outpatient basis [9]. The other second most common complication in our study is malunion in 4 patients (12%), a study by Adair *et al*. in 2003 showed that of a 304 cases treated there were 103 complications in total. Of which 43 patients (14%) experienced problems with malunion, this is consistent with our findings. Moreover, in the same study 12 patients (4%) experienced neural problems in the form of nerve pain during distraction or permanent nerve damage which were consistent with our neurovascular complication rate of (6%) [10]. In a study by Vargas, *et al*. in 2007, it has been shown that one patient had a delayed union of the callus and one patient with fracture which was observed during the study [16].

The third most common complication in our study was difficulty sleeping and psychiatric agitation, similar findings were reported by a study published in 1990 by Paley *et al*. found that patients will suffer from difficulty sleeping, [12]. Similar study by Yildiz C *et al*. showed a high incidence of sleep disturbances among Illizarov patients 13 out of 40 (32.5%) compared to our results (9%) [24]. Moreover, paresthesia was reported in several studies by Velazquez *et al*.

in 2013(8080) and by lascombes, *et al*. in 2012 [25]. There were no contractures of the soft tissues, subluxation and dislocation of the adjacent joints, osteoporosis of the lengthened bone in our study as opposed to several published studies [12]. We found that there is an association between a number of indications and a number of post-op complications.

5. Limitations

There were two main limitations in this study. The first one, there was no classification of the complications. The other limitation is we did not mention how we managed these complications. However, those limitations will be taken into account in the future by suggesting a classification to these complications. Satisfaction of our patients regarding the outcome is a good area to be investigated in the future.

6. Conclusion & Recommendation

There was a minimal complication rate associated with this technique in our institution compared to published studies. Several medical conditions were the indication for this procedure, primarily motor vehicle accidents deformities.

Further larger multicenter studies including large number of patients are recommended to ensure accurate complication rate report are needed in order to confirm the results we found in this study.

A good knowledge of the Ilizarov technique is necessary to perform a correcting or lengthening program with a low rate of complications. However, while numerous potential complications continue to exist, most complications are now minor and easily treatable by a greater understanding of common complication and considerable experience of the technique.

We recommend more specialized training for general orthopedic surgeons for this technique as few surgeons in Saudi Arabia perform this procedure especially in pediatrics orthopedic surgery.

7. Conflict of interest

All authors declare no conflict of interest.

8. References

1. Sellmayer A, Strasser T, Spelsberg F, Weber PC. Increased leukotriene B4 synthesis in patients with primary hyperparathyroidism is normalized after parathyroidectomy: a study comparing parathyroidectomy to thyroid adenomectomy. J Clin Endocrinol Metab. 1987; 64(2):387-90.
2. White SH, Kenwright J. The timing of distraction of an osteotomy. The Journal of bone and joint surgery British. 1990; 72(3):356-61.
3. Goldstein RY, Jordan CJ, McLaurin TM, Grant A. The evolution of the Ilizarov technique: part 2: the principles of distraction osteosynthesis. Bull Hosp Jt Dis. 2013; 71(1):96-103.
4. White SH, Kenwright J. The importance of delay in distraction of osteotomies. The Orthopedic clinics of North America. 1991; 22(4):569-79.
5. Ajmera A, Verma A, Agrawal M, Jain S, Mukherjee A. Outcome of limb reconstruction system in open tibial diaphyseal fractures. Indian journal of orthopaedics. 2015; 49(4):429-35.
6. Agashe MV, Song SH, Refai MA, Park KW, Song HR. Congenital pseudarthrosis of the tibia treated with a combination of Ilizarov's technique and intramedullary rodding. Acta orthopaedica. 2012; 83(5):515-22.
7. Vargas Barreto B, Caton J, Merabet Z, Panisset JC, Pracros JP. Complications of Ilizarov leg lengthening: a comparative study between patients with leg length discrepancy and short stature. International orthopaedics. 2007; 31(5):587-91.
8. Vidyadhara S, Rao SK. Ilizarov treatment of complex tibial pilon fractures. International orthopaedics. 2006; 30(2):113-7.
9. Marsh DR, Shah S, Elliott J, Kurdy N. The Ilizarov method in nonunion, malunion and infection of fractures. The Journal of bone and joint surgery British. 1997; 79(2):273-9.
10. Adair A, Narayan B, Andrews C, Laverick M, Marsh D. The Complication Rate In Ilizarov Surgery. Journal of Bone & Joint Surgery, British. 2003; 85-B(SUPP II):139.
11. Umer M, Rashid H, Umer HM, Raza H. Hip Reconstruction Osteotomy by Ilizarov Method as a Salvage Option for Abnormal Hip Joints. BioMed Research International. 2014, 6.
12. Paley D. Problems, obstacles, and complications of limb lengthening by the Ilizarov technique. Clinical orthopaedics and related research. 1990; (250):81-104.
13. Velazquez RJ, Bell DF, Armstrong PF, Babyn P, Tibshirani R. Complications of use of the Ilizarov technique in the correction of limb deformities in children. The Journal of bone and joint surgery American. 1993; 75(8):1148-56.
14. Poposka A, Atanasov N, Dzoleva-Tolevska R. Use of ultrasonography in evaluation of new bone formation in patients treated by the method of Ilizarov. Prilozi. 2012; 33(1):199-208.
15. Spiegelberg B, Parratt T, Dheerendra SK, Khan WS, Jennings R, Marsh DR. Ilizarov principles of deformity correction. Annals of the Royal College of Surgeons of England. 2010; 92(2):101-5.
16. Vargas Barreto B, Caton J, Merabet Z, Panisset JC, Pracros JP. Complications of Ilizarov leg lengthening: a comparative study between patients with leg length discrepancy and short stature. International orthopaedics. 2007; 31(5):587-91.
17. Looney RE. Demographic perspectives on Saudi Arabia's development. Popul Bull ECWA. 1985; (26):93-111.
18. MT. The Pattern of Pelvic Fractures in Asir Region of Saudi Arabia. Bahrain Medical Bulletin. 1992; 20(2).
19. Aldawood AS, Alsultan M, Haddad S, Alqahtani SM, Tamim H, Arabi YM. Trauma profile at a tertiary intensive care unit in Saudi Arabia. Ann Saudi Med. 2012; 32(5):498-501.
20. Metka M. [Osteoporosis and estrogens]. Gynakol Rundsch. 1989; 29(4):232-7.
21. JC. Traitement des inégalités de longueur des membres inférieures et des sujets de petite taille chez l'enfant et l'adolescent. Rev Chir Orthop Reparatrice Appar Mot. 1991; 77(1):31-80.
22. Paschoalin VM, Silva JT, Panek AD. Identification of an ADPG-dependent trehalose synthase in Saccharomyces. Curr Genet. 1989; 16(2):81-7.
23. Al-Dilaimi SK, Aumiller JC, Johnson RH, Blatz PE. Spectroscopic examination of hydrogen bonding and proton transfer in model Schiff bases related to the visual pigment chromophore. Photochem Photobiol. 1987; 46(3):403-12.
24. Yildiz C, Uzun O, Sinici E, Atesalp AS, Ozsahin A, Basbozkurt M. [Psychiatric symptoms in patients treated

with an Ilizarov external fixator]. Acta Orthop Traumatol Turc. 2005; 39(1):59-63.
25. Lascombes P, Popkov D, Huber H, Haumont T, Journeau P. Classification of complications after progressive long bone lengthening: proposal for a new classification. Orthop Traumatol Surg Res. 2012; 98(6):629-37.