Scientific Research Publishing

Open Journal of Orthopedics, 2023, 13, 335-342
https://www.scirp.org/journal/ojo
ISSN Online: 2164-3016
ISSN Print: 2164-3008

Equalisation of Lower Limb Length in Young Adults Using Internal Osteosynthesis: A Case Report of 22 Patients

Mohamed Idrissa Seidou[1*], Issa Soumana Yahaya[1], Ali Moussa Niandou[1], Abassa Seyni Zirbine[1], Adoul Aziz Seini Badio[1], Seyni Souna Badio[1,2]

[1]Traumatology and Orthopedics Department, Amirou Boubacar Diallo National Hospital, Niamey, Niger
[2]Faculty of Health Sciences, Abdou Moumouni University of Niamey, Niamey, Niger
Email: *mohamedidrissa96@yahoo.fr

How to cite this paper: Seidou, M.I., Yahaya, I.S., Niandou, A.M., Zirbine, A.S., Badio, A.A.S. and Badi, S.S. (2023) Equalisation of Lower Limb Length in Young Adults Using Internal Osteosynthesis: A Case Report of 22 Patients. *Open Journal of Orthopedics*, **13**, 335-342.
https://doi.org/10.4236/ojo.2023.138033

Received: June 12, 2023
Accepted: August 21, 2023
Published: August 24, 2023

Abstract

Introduction: Inequality in the length of the lower limbs has an impact on the stability and function of the musculoskeletal system because of the imbalance it causes in our bodies. Several treatment modalities were used by practitioners. The aim of this study was to evaluate the anatomical and functional results of length equalisation of the lower limbs using internal osteosynthesis in the Orthopaedic and Traumatological Surgery Department of the Amirou Boubacar Diallo National Hospital in Niamey. **Patients and method:** This was a retrospective, prospective study of 22 patients from January 2010 to November 2015, a period of 5 years. The patients concerned were aged at least 18 years and had undergone a femoral shortening osteotomy not exceeding 5 cm on the contralateral healthy limb with a screw plate as the internal osteosynthesis device. **Results:** The average age of our patients was 24.18 years (18 to 48 years). The etiologies of these length inequalities were: vascular 54.55% (n = 12), post-traumatic 27.27% (n = 6), post-infectious 13.64% (n = 3) and neuromuscular 4.54% (n = 1). The mean length inequality of our patients was 4.93 cm, with extremes ranging from 4 to 8 cm. At an average follow-up of 6.5 months (6 to 24 months), our functional results were satisfactory overall. **Discussion:** Despite the significant nature of our initial inequalities, which were moderate and severe, we ended up with slight inequalities or even total correction for some of our patients. **Conclusion:** Inequality in the length of the lower limbs is a handicap that requires appropriate management.

Keywords

Equalisation, Length, Lower Limb, Internal Osteosynthesis

1. Introduction

The treatment of length inequalities in the lower limbs remains an extremely difficult problem. It depends on the extent of the length inequality, but also on the age at which the diagnosis and equalisation treatments are carried out [1]. These inequalities in length and axis disorders of the lower limbs constitute a group of acquired or malformative structural pathologies. This inequality or anisomelia is defined by an asymmetry in the length of the limbs [2]. Over the years, different authors have used different surgical treatment modalities [1] [3] [4] [5], each with its own advantages and disadvantages.

In order to better understand the potential of lower limb length inequalities (ILMI) to modify the postural attitude, in view of its consequences on the life of the patient and the absence of data on its frequency in our country, we considered it useful to initiate this study.

The aim of this retrospective and prospective study was to evaluate the anatomical and functional results of lower limb length equalisation by internal osteosynthesis in a series of 22 patients from the Orthopaedic and Traumatological Surgery Department of the Amirou Boubacar Diallo National Hospital in Niamey-Niger.

2. Patients and Method

This is a retrospective, prospective study conducted over a 5-year period from January 2010 to November 2015 on 22 patients of both sexes who were operated on in the orthopaedic surgery and traumatology department of the Amirou Boubacar Diallo National Hospital in Niamey-Niger.

Our patients were selected for this study on the basis of the following inclusion criteria:

- patients aged at least 18 years who had undergone surgery in the department for length equalisation of the lower limbs by femoral subtraction osteotomy (shortening) of the contralateral healthy limb with screw plate fixation
- patients whose femoral subtraction osteotomy did not exceed 5 cm
- patients who had a limb length inequality of at least 4 cm and who underwent surgery during the study period.

The exclusion criteria concerned:

- all patients operated on for lower limb length inequality using surgical methods other than internal screw-plate osteosynthesis
- patients under 18 years of age operated on for unequal length
- patients whose primary care was orthopaedic treatment

The inequality in the length of the lower limbs is measured on a patient in a supine or standing position, avoiding any decompensatory posture (scoliosis, hyperlordosis, etc.). Using a tape measure, the length of the lower limbs is measured on each side by the distance from the anterior superior iliac spine (ASIS) to the medial or lateral malleolus; the difference in length constitutes the length inequality.

ILMI is classified according to its extent; it is defined in millimetres or centimetres and is described as mild, moderate or severe. McCaw and Bates [6] proposed the following classification in 1991:

1) Mild ILMI: less than 3 cm;

2) Moderate ILMI: 3 to 6 cm;

3) Severe ILMI: more than 6 cm.

Results were assessed on the basis of the following anatomical and functional criteria: pain, lameness, residual inequality, consolidation time, limb axis (varum, valgum, flexum, recurvatum) and degree of stiffness

Functional results were classified as:

- very good results if (no pain, no lameness, no stiffness, no deviation of the limb axis, consolidation time < 100 days, iso-long limbs or residual inequality < 1 cm),
- good results if (no pain, no lameness, no stiffness, no deviation of limb axis, consolidation time < 100 days, residual inequality 1 to 2 cm)
- average results if (no pain, no lameness, no stiffness, no deviation of limb axis, consolidation time 100 to 120 days, residual inequality 2 cm < ILMI < 3 cm)
- poor results if (presence of pain, presence of lameness, presence of stiffness, deviation of limb axis, consolidation time > 120 days, residual inequality ≥ 3 cm).

Figure 1 shows a clinical image of a patient with a right ILMI. This patient underwent internal osteosynthesis with a screw plate to correct this length inequality. Figure 2 shows a front and side X-ray of her femur showing internal osteosynthesis with a screw plate of a subtraction osteotomy.

(a) (b)

Figure 1. (a) Inequality in right limb length of 4 cm before surgery; (b) Limb of same length after surgery.

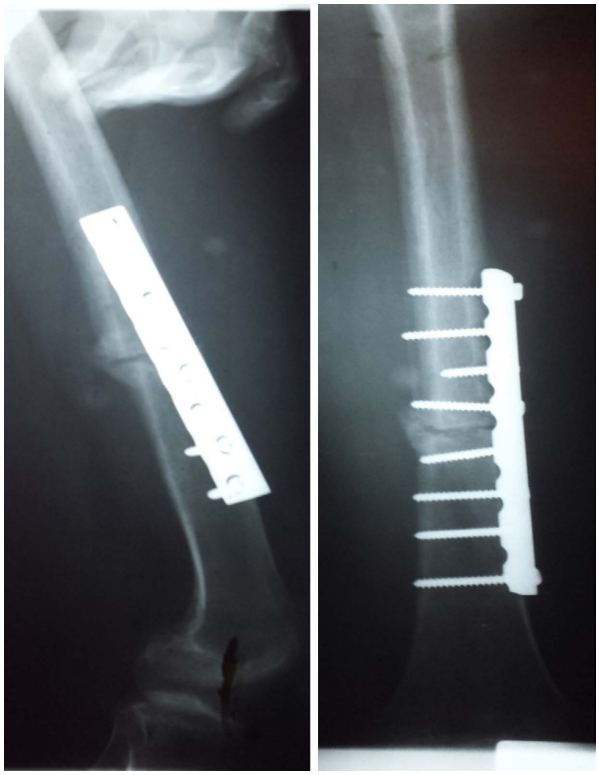

Figure 2. Post-operative radiograph (90-day) face and profile of the femur of a subtraction osteotomy with screw plate fixation.

3. Résultats

In total, we collected 22 patient files in our series. The sociodemographic and clinical characteristics of the patients are shown in Table 1.

At an average follow-up of 6.5 months (6 to 24 months) and according to our functional evaluation criteria defined above, we obtained very good results in 63.64% (n = 14) of cases, good results in 31.82% (n = 7) of cases and average results in 4.54% (n = 1) of cases. The evolution after revision was successful. The extent of lower extremity length discrepancy after surgery is distributed as follows in Table 2.

4. Discussions

In our series, the predominant sex was male, with a frequency of 54.55% (n = 12), giving a sex ratio of 1.2. This male predominance has been reported by several authors [1] [7] [8] [9]. The mean age of our patients was 24.18 years, ranging from 18 to 48 years. Young people and adults are most affected. In order to avoid iterative equalisation, we have deliberately taken subjects at the end of their growth period in order to carry out a definitive equalisation in a single procedure. Some authors, such as MENARD H. *et al.* [9], report in the course of their study an average age close to ours, with 29.3 years (18 to 46 years), while CATON J. [1] and NOVIKOV KI *et al.* [3] obtain an average age of 23.6 years (14 to 50 years) and 25 years (14 to 68 years) respectively.

Table 1. Socio-demographic and clinical characteristics.

Variables	(n) workforce	(%)
average age	24.18 years (18 - 48 years)	
Sex		
M	12	54.55
F	10	45.45
Etiologies		
Vascular	12	54.55
Post-traumatic	6	27.27
Post-infectious	3	13.64
Neurovascular	1	4.54
Side reached		
Left	13	59.09
Right	9	40.91
Pain and lameness	12	54.55
Isolated lameness	10	45.45
Average ILMI Seat of correction	4.93 cm (4 - 8 cm)	
Proximal femur	17	77.27
Medium femur	4	18.18
Distal femur	1	4.55

M: Male, F: Female; The sex ratio (M/F) was 1.2. The average time to consolidation for our patients was 13 weeks (12 to 16 weeks). Before surgical correction, moderate ILMI (4 to 6 cm) was observed in 90.91% (n = 20) of patients. Large ILMI (>6 cm) were observed in 9.09% (n = 2) of patients.

Table 2. Distribution of patients according to the extent of ILMI after surgical correction.

ILMI after surgical correction	(n) workforce	(%)
Iso long (without ILMI)	5	22.73
ILMI < 1 cm	9	40.91
IILMI of 1 to 2cm	7	31.82
ILMI > 2 cm	1	4.54
TOTAL	**22**	**100**

The 18 - 28 age group was most affected, with 18 (81.82%) cases. The majority of these cases are ILMI acquired through trauma, infection or necrotising osteochondritis. In our countries, patients are very often seen in consultation, either because they become aware of the disease with age, or after the disease has worsened. Added to this are the failures of traditional treatments, which further complicate the management of ILMI in our countries.

The average inequality (or extent of shortening) of our patients is 4.93 cm (4

to 8 cm), while CATON J. [1] found an average shortening of 3.59 cm (2.5 to 5.5 cm). Our sizes of inequality are greater than those reported by CATON J. [1]; we have very significant ILMI which, if left untreated, will have an impact on the overlying and underlying joints (lumbosacral spine and knee). In our series, we are dealing with limb length inequality in a subject with low growth potential.

The shortening osteotomy involved the proximal femur in 77.27% (n = 17) of cases, the middle third of the femur in 18.18% (n = 4) of cases and the distal femur in 4.55% (n = 1) of cases,MORASIEWICZ L. *et al.* [10] found respective frequencies of 50% (n = 8) for the femoral shaft, 31.25% (n = 5) for the distal epiphysis of the femur and 18.75% (n = 3) for the proximal epiphysis of the femur. The difference observed could be explained by the different surgical techniques used: internal osteosynthesis (subtraction osteotomy with screw plate fixation) in our series and external osteosynthesis (Ilizarov method) for MORASIEWICZ L. *et al.* [10].

Before correction according to the classification [6]: ILMI of moderate extent (4 to 6 cm) in our study were observed in 90.91% (n = 20) of patients, ILMI of large extent (>6 cm) were observed in 9.09% (n = 2) of patients.

After correction: according to the results of the correction, we had obtained 40.91% (n = 9) cases of residual inequality < 1 cm, 31.82% (n = 7) cases of residual inequality of 1 to 2 cm, 22.73% (n = 5) cases of iso-long lower limbs (where the correction was total), 4.54% (n = 1) cases of residual inequality of 2.5 cm. According to the classification [6], we started with moderate and severe ILMI and ended up with mild ILMI.

Despite the significant inequalities at the outset, we have achieved total correction for some of our patients, and for others a significantly reduced residual inequality that has no influence whatsoever on the functionality of the limb.

Comparing patients treated with internal fixation: in our series we have 1/22 (4.54%) cases of complication such as disassembly of osteosynthesis material, CATON J. [1] reported a complication rate of 5/34 (14.70%) of haemorrhagic and infectious origin, GUICHET JM. *et al.* [4] reported a complication rate of 9/31 (29.03%) of hip subluxation, superficial wound infection or popliteal thrombosis.

As for patients treated with external fixation (Ilizarov), NOVIKOV KI. *et al.* [3] report a complication rate of 48/138 (37%) such as soft tissue or bone infection, PREVOT J. *et al.* [5] report a complication rate of 52/26 (200%) such as pin rupture, delayed graft healing, fracture, axial deviation after fixator removal, peroneal nerve damage, compartment syndromes, motor paralysis, knee stiffness, superficial infections around pins, osteitis, or arthritis.

It is clear that external fixation is more prone to complications than internal osteosynthesis.

In our series, we used a simple technique (a subtraction osteotomy of the contralateral healthy limb with compression screw-plate fixation) to achieve simple post-operative management.

Our functional results were satisfactory overall, despite the rigorous evaluation criteria.

The limitations of our study are essentially linked to the size of our sample, which is much smaller than that of most authors [1] [3] [4].

Added to this is the technique used to measure limb length inequality, which is done manually using a tape measure in our series, whereas there are currently much more effective and accurate methods available, such as telemetry, which considerably reduces limb length inequality measurement errors.

5. Conclusions

Inequality in the length of the lower limbs is a handicap insofar as it leads to lameness or pain, a very noticeable symptom with all its consequences for the biomechanics of the pelvis and spine.

These inequalities in length beyond a certain extent require appropriate surgical management. However, as the treatment is difficult and delicate, it requires a more appropriate strategic and therapeutic choice, to achieve a better anatomical and functional result.

Contributions

Mohamed Idrissa Seidou: conception and writing of the article.

Seyni Souna Badio: proofreading and correction of the article.

Issa Soumana Yahaya, Ali Moussa Niandou, Adoul Aziz Seini Badio, Abassa Seyni Zirbine contributed to the writing of this article.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Caton, J. (2011) Place of Femoral Shortening According to the Blount and Trillat Technique in the Treatment of Length Inequalities of the Lower Limbs in Connection with 34 Cases. *Memoires National Academy of Surgery*, **10**, 23-26.

[2] Dimitri, C., Raimonda, V., Catherine, G., Odile, D., Sophie, P., Pierre, D., *et al.* (2017) Axis Corrections and Lengthening of the Lower Limbs in Pediatric Orthopedics. *Swiss Medical Review*, **13**, 427-432.

[3] Mccaw, S.T. and Bates, B.T. (1991) Biomechanical Implications of Mild Leg Length Inequality. *British Journal of Sports Medicine*, **25**, 10-13. https://doi.org/10.1136/bjsm.25.1.10

[4] Trigui, M., Ayadi, K., Ellouze, Z., Gdoura, F., Zribi, M. and Keskes, H. (2008) Treatment of Bone Loss in the Limbs by Segmental Bone Transport. *Revue de Chirurgie Orthopédique et Réparatrice de l'Appareil Moteur*, **94**, 628-634. https://doi.org/10.1016/j.rco.2008.02.007

[5] Craviari, T., Berard, J., Willemen, L. and Rcot, K.R. (1998) Percutaneous Epiphysiodesis. Analysis of a Series of 60 Full-Grown Patients. *Rev Chir Orthop Reparatrice Appar Mot*, **84**, 172-179.

[6] Menard, H. and Fraisse, N. (2011) Posture and Inequalities in the Length of the Lower Limbs. *French Phlebological Editions*, **64**, 34-39.

[7] Novikov, K.I., Subramanyam, K.N., Muradisinov, S.O., Novikova, O.S. and Kolesnikova, E.S. (2014) Cosmetic Lower Limb Lengthening by Ilizarov Apparatus: What Are the Risks? *Clinical Orthopaedics and Related Research*, **472**, 3549-3556. https://doi.org/10.1007/s11999-014-3782-8

[8] Morasiewicz, L., Orzechoski, W., Kulej, M. and Stepniewski, M. (2007) The Results of Treatment of Bone Defects and Non-Union within the Femoral Shaft with Shortening of Femur Using Ilizarov Method. *Ortop Traumatol Rehabil*, **9**, 366-376.

[9] Guichet, J.M., Deromedis, B., Donnan, L.T., Peretti, G., Lascombes, P. and Bado, F. (2003) Gradual Femoral Lengthening with the Albizzia Intramedullary Nail. *The Journal of Bone & Joint Surgery*, **85**, 838-848. https://doi.org/10.2106/00004623-200305000-00011

[10] Prevot, J., Guichet, J.M., Leneveu, E. and Kuhnast, M. (1994-1995) Bilateral Lengthening of Short Lower Limbs. 26 Cases Treated with the Ilizarov Method. *Chirurgie*, **120**, 360-367.