Journal of Case Reports and Studies
Volume 11 | Issue 1
ISSN: 2348-9820

Case Report Open Access

3D Clinical Effect of Printing Technique in the Treatment of Complex Pelvic and Acetabular Fractures

Wang Minglu, Luo Huasong*, Chu Wei, Majinliang, Bao Yunping, Zeng Yinhao and Abdul Samad

The First Affiliated Hospital of Yangtze University, the first people's Hospital of Jingzhou City, Hubei Province, 434000

***Corresponding Author:** Luo Huasong, The First Affiliated Hospital of Yangtze University, the first people's Hospital of Jingzhou City, Hubei Province, 434000

Citation: Wang Minglu, Luo Huasong, Chu Wei, Majinliang, Bao Yunping, et al., (2023) 3D Clinical Effect of Printing Technique in the Treatment of Complex Pelvic and Acetabular Fractures. J Case Rep Stud 11(1): 102

Abstract:

Objective: To compare the clinical efficacy of 3D printing assisted and traditional open reduction and internal fixation in the treatment of complex pelvic and acetabular fractures.

Methods: Twelve patients with complex pelvic acetabular fractures were randomly divided into 3D group and conventional group, 6 cases in each group. Before operation, all patients completed routine examinations such as whole blood analysis, coagulation analysis, electrolyte of liver and kidney function, blood glucose, complete set before blood transfusion, urine analysis, electrocardiogram, color Doppler ultrasound of liver, gallbladder, pancreas, spleen and kidney, and imaging examinations such as pelvic anteroposterior X-ray film and pelvic CT 3D. In the 3D group, the 1:1 physical model was made by 3D printing technology, and the operation scheme was designed and "pre operation" was carried out on the model to complete the osteotomy of the fracture end, the correction of the pelvis and acetabulum, and the reduction and internal fixation. The direction and angle of the fixation plate and screw required for shaping were marked and applied in the actual operation. In the routine group, X-ray and CT three-dimensional reconstruction of pelvis and acetabulum were performed routinely, and internal fixation was completed combined with the clinical experience of surgeons.

Results: The operation time, intraoperative blood loss and postoperative drainage volume of 3D group were significantly less than those of conventional group ($P < 0.05$). According to Matta imaging standards, the fracture reduction quality of 3D auxiliary group was excellent in 4 cases, good in 1 case, fair in 1 case, the excellent and good rate was 88.89%; the conventional group was excellent in 2 cases, good in 1 case, fair in 3 cases, the excellent and good rate was 72.22%, the difference was statistically significant ($P < 0.05$).

Conclusion: 3D printing technology in the treatment of complex pelvic acetabular fractures is helpful for the surgeons to understand the fracture characteristics, formulate optimized and accurate personalized operation plan before operation, improve the safety and accurate reduction of operation, shorten the operation time, reduce the occurrence of postoperative complications, and improve the clinical efficacy.

Keywords: complex pelvic and acetabular fractures; 3D printing technology; open reduction and internal fixation

Introduction

Multiple high-energy injuries and complex pelvic acetabular fractures are challenging injuries in orthopedics trauma department, which are not rare in clinic. Due to the irregular structure of pelvis and acetabulum, and adjacent to the important blood vessels and nerves [2],the operation is more difficult, the disability rate is higher, the postoperative complications are more, and the curative effect is poor. As a kind of rapid prototyping technology, 3D printing technology has been developed rapidly in the field of orthopedics in recent years. Combined with CT three-dimensional reconstruction technology, it realizes the transformation from virtual model to solid model, and provides a new auxiliary treatment method for the surgical treatment of complex pelvic and acetabular fractures [3]. In our hospital, from January to December 2018, 3D printing technology was used to treat 6 cases of complex pelvis and acetabulum. Compared with conventional treatment methods, satisfactory clinical effect was achieved, which is reported as follows.

Data and Methods

General Information

From January 2018 to December 2019, 12 patients with complex pelvic acetabular fractures were included in this study, including 8 males and 4 females, aged 32-66 years, with an average age of 49 years. There were 3 cases of falling injury and 9 cases of traffic accident. All the operations were performed by the same group of doctors. According to whether 3D printing assisted technology was used or not, they were divided into 3D assisted group and conventional operation group, 6 cases in each group. The patients in 3D group agreed to apply 3D assisted printing technology and were followed up.

Operation Method

All patients were completed preoperative whole blood analysis, coagulation analysis, liver and kidney function electrolytes, blood glucose, blood transfusion, urine analysis, ECG

The contraindications of operation were excluded by routine examination such as CT, ultrasonography of liver, gallbladder, pancreas, spleen and kidney, pelvic X-ray and pelvic CT3D. All patients were treated with intravenous inhalation anesthesia, according to the type of fracture to determine the operation plan, take the appropriate operation position.

In the 3D assistant group, the scanning data were input into the computer, and the data were processed by Mimics software. After image segmentation and calculation, the 3D model was exported to. STL format file, and the 1:1 pelvic acetabular model was made by 3D printing technology 360 ° visual observation and understanding of deformity and fracture, develop personalized surgical plan, through the pre "operation", select the best surgical approach, complete fracture reduction, pre bending plastic plate, select the appropriate screw and angle for internal fixation, mark on the model, and bring it into the operating room for reference. The pre bent shaped steel plate and screw were marked and packaged for disinfection, which was to be used accurately in the actual operation. According to the surgical approach designed before operation, the fracture site should be exposed step by step, the callus around the fracture end should be removed, the contracture soft tissue should be loosened, and the important blood vessels and nerves should be well protected. According to the pre "operation" steps on the model, the reduction order between the fracture blocks should be determined, the anatomical reduction should be carried out, and the Kirschner wire should be used for temporary fixation Screw fixation, fluoroscopy confirmed that the fracture reduction and fixation were good, drainage tube was placed, and the incision was sutured layer by layer.

According to the preoperative imaging data, the conventional group made the operation plan, selected the operation approach, combined with the clinical experience of the operator to complete the reduction and internal fixation

Jingzhou medical and health science and technology project in 2019, 2019hc37Fixation. Conventional incision was used to cut the skin and subcutaneous tissue. After separating the soft tissue, the broken end of the fracture was exposed. According to the previous operation experience of the operator and the displacement of the fracture block during the operation, the reduction was carried out. Then according to the reduction situation and anatomical structure, the bending plate was shaped, the plate was placed, and the screw was fixed.

Evaluation Index

The operation time, intraoperative blood loss and postoperative drainage were recorded. Postoperative X-ray film, pelvic CT scan and 3D were reviewed, and the effect of fracture reduction was evaluated by Matta imaging scoring standard [5].

Statistical Methods

Spss19.0 software was used for statistical analysis of the data. The operation time, intraoperative blood loss and postoperative drainage were normal distribution data, and the variance was homogeneous, expressed as $X \pm S$. t test was used for comparison, chi square test or Fisher's exact test was used for comparison of count data, and $P < 0.05$ showed that the difference was statistically significant.

Results

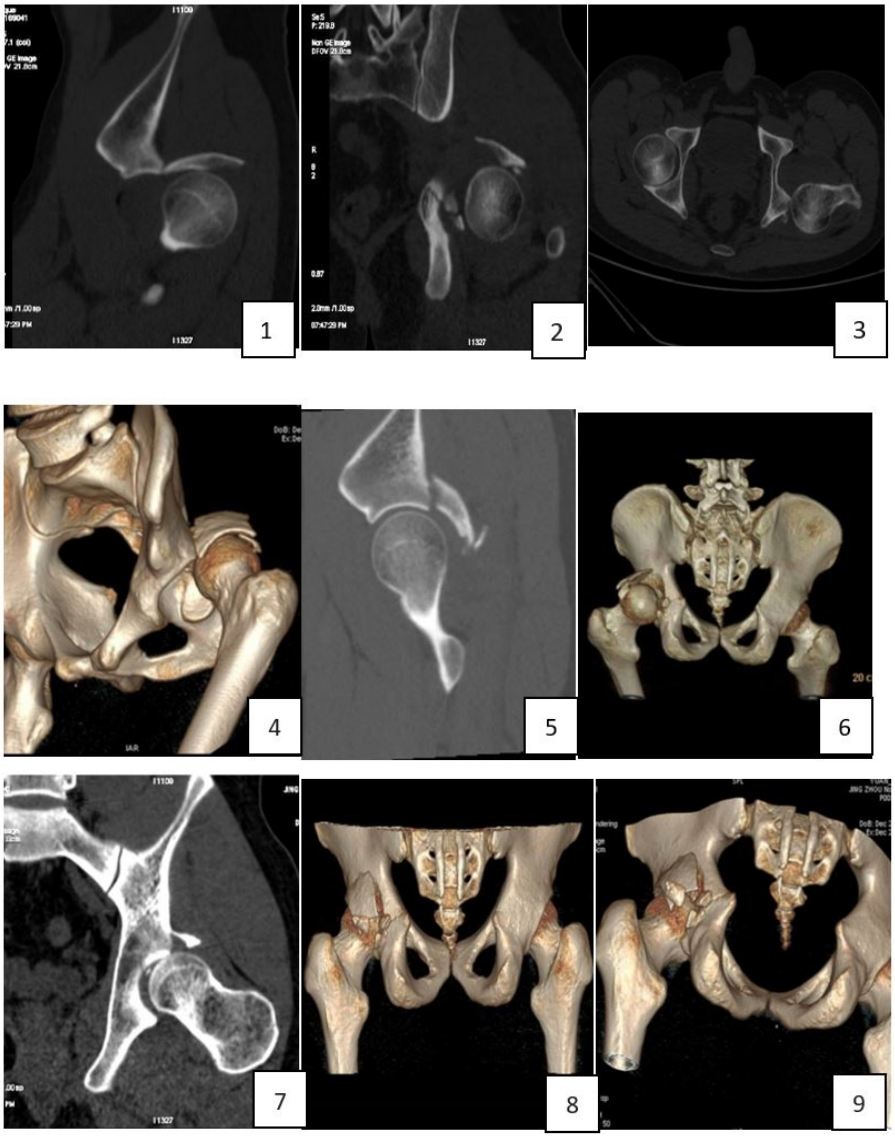
The operation time, intraoperative blood loss and postoperative drainage volume of 3D auxiliary group were significantly less than those of conventional group, and the differences were statistically significant ($P < 0.05$).

Group	Cases	Operation time (min)	Intraoperative blood loss (mL)	Postoperative drainage volume (mL)
3D Group	6	152.03±29.09	1132.80±70.84	108.51±8.18
Routine group	6	187.53±18.85	1401.62±43.37	182.69±15.81
P value	-	< 0.05	< 0.05	< 0.05

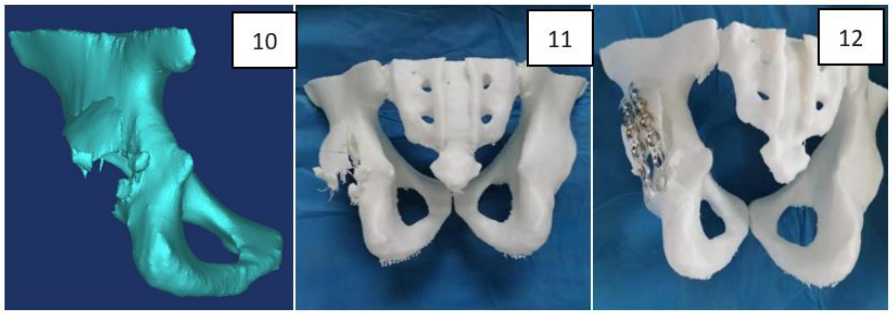
Table 1: Comparison of perioperative conditions between the two groups

Matta imaging standard was used to evaluate the fracture reduction. In the 3D auxiliary group, 4 cases were excellent, 1 case was good, 1 case was fair, and the excellent and good rate was 88.89%; in the conventional group, 2 cases were excellent, 1 case was good, and 3 cases were fair, and the excellent and good rate was 72.22%. The difference between the two groups was statistically significant ($P < 0.05$).

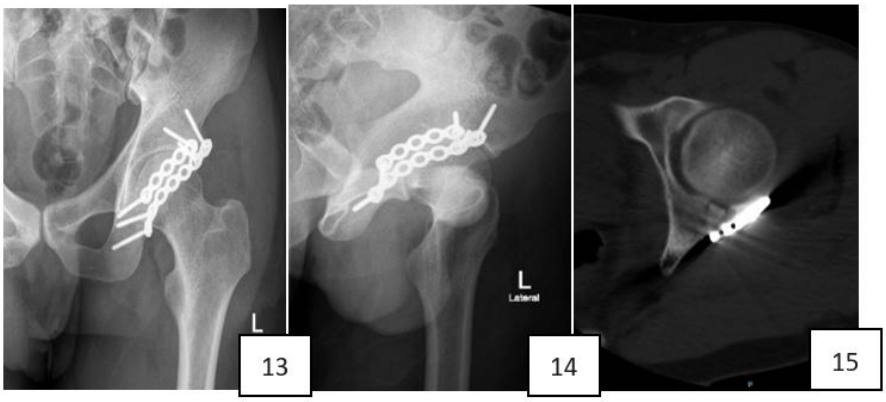
Preoperative CT and 3D reconstruction



3D Printing model



Postoperative imaging examination



Discussion

For complex acetabular fractures, traditional surgery only relies on the surgeon's naked eye and experience for positioning, and its reliability and accuracy are inevitably questioned [5]. 3D printing technology with accurate three-dimensional physical model can show complex acetabular fractures more intuitively and stereoscopically, which is helpful for multi angle observation. Before operation, the doctor can have a comprehensive understanding of the diagnosis and classification of fracture according to the three-dimensional model, so as to formulate the best operation plan, and compare it with the operation field during the operation, so as to provide help for the smooth operation and anatomical reduction. 3D printing fracture model can not only distinguish fracture line and fragment, but also accurately observe the position of fracture line and the relationship between different fracture blocks, so that doctors can have intuitive and three-dimensional feeling of fracture shape, which is helpful to the three-dimensional positioning of fracture block and the correct classification of fracture [7]. In addition, by observing the position of fracture line and the displacement of fracture block, the exposure range was determined, so as to select the most appropriate surgical approach. Simulation surgery on 3D printing fracture model is an advantage that traditional preoperative planning does not have. The reduction and fixation of complex acetabular fractures has always been difficult. 3D printing fracture model can effectively plan the reduction and fixation methods. By simulating the operation, we can pre bend the plate and screw, choose the most appropriate fixation method, and judge the angle of screw placement to avoid it entering the joint. According to the preoperative design, the reduction is more accurate and the fixation is more reasonable and reliable. It can reduce the time of reduction, improve the quality of reduction, reduce the operation time, and reduce the possibility of infection, intraoperative blood loss and other complications. Bagaria et al. [8] used 3D printing technology to make pelvic acetabular model before operation, completed pre operation in the model, improved the preoperative design, made the operation safer and smoother in the actual operation, and achieved good curative effect. 3D printing technology can be better used for preoperative planning. For doctors who are not yet experienced, it can indirectly improve the prognosis of patients by improving the quality of intraoperative reduction and the reliability of fixation through preoperative simulation surgery. This study showed that: the operation time, intraoperative blood loss and postoperative drainage of 3D group were significantly less than those of conventional operation group, and the fracture reduction of 3D group was significantly better than that of conventional operation group by using Matta imaging standard after operation. In the 3D printing model, "pre operation" is carried out in advance, including surgical approach, reduction, shaping plate, fixation, clear screw placement position and screw length, so as to avoid repeatedly shaping plate, drilling, peeling callus and surrounding soft tissue during operation, and effectively reduce operation time, intraoperative bleeding, incision infection and other related complications [9].

At the same time of assisted surgery, 3D printing fracture model can also be used for teaching. Because of its complex anatomical structure, acetabulum is more challenging than simple fractures such as diaphysis. For young doctors, it is impossible to operate for patients by hand, which makes the learning curve longer. Reduction and fixation on 3D printing fracture model is not only feasible, but also can be repeated for many times, so as to experience the characteristics and effects of different reduction and fixation methods, so as to gradually understand the key points of surgical treatment of acetabular fracture, which can greatly shorten the learning curve [10]. In addition, 3D printing technology can make patients and their families more intuitive and comprehensive understanding of the fracture situation and the risks and complications of surgery, reduce the occurrence of doctor-patient disputes, and is conducive to doctor-patient communication [11], and 3D printing technology can reduce the rate of missed diagnosis and misdiagnosis, and reduce the number of intraoperative radiation.

To sum up, 3D Printing technology in the treatment of complex pelvic acetabular fractures can help surgeons to better understand the characteristics of fractures, formulate optimized, safe and accurate individualized operation plan before operation, improve the accuracy of internal fixation, save operation time, reduce the number of radiation exposure of doctors and patients, and reduce the occurrence of postoperative complications, which can break through the imagination of orthopedics doctors and improve the quality of operation To achieve the goal of preoperative virtual design perfectly. It is feasible to improve the clinical efficacy, and is worthy of promotion.

Reference

1. Qiu Daodi, Zhou Dongsheng, Li Lianxin, et al. (2019) Incidence and clinical significance of "death crown" blood vessels [J]. Chinese Journal of orthopedics 39: 284-90.

2. Philip Tack, Victor Jan, Gemmel Paul, et al. 3D-printing techniques in a medical setting: a systematic literature review[J]. Biomedical Engineering Online, 15: 115.

3. Huang fuming, fan Shicai (2019) Research progress of 3D printing technology in the treatment of pelvic acetabular fractures [J]. Chinese Journal of clinical anatomy 37: 347-50.

4. Y Zhuang, Cao S, Lin Y, et al. (2016) Minimally invasive plate osteosynthesis of acetabular anterior column fractures using the two-incision minimally invasive approach and a preshaped three dimension plate[J]. Int Orthop 40: 2157-62.

5. S-M Howell, Papadopoulos S, Kuznik K-T, et al. (2013) Accurate alignment and high function after kinematically aligned TKA performed with generic instruments[J]. Knee Surg Sports Traumatol Arthrosc 21: 2271-80.

6. Zhang Guoming, Zhou Dongsheng, he Yu, et al. (2016) Application of 3D printing technology in the treatment of complex acetabular fractures [J]. Chinese Journal of orthopedics and trauma 18: 306-11.

7. V Bagaria, Bhansali R, Pawar P (2018) 3D printing- creating a blueprint for the future of orthopedics: Current concept review and the road ahead![J]. J Clin Orthop Trauma 9: 207-12.

8. Hu Linyong, Chen Qiusheng, Zhong Meilian, et al. (2016) Clinical application of 3D printing in acetabular fracture and pelvic fracture [J]. Chinese Journal of practical diagnosis and treatment 30: 867-9.

9. Zhang Hua (2019) Application evaluation of 3D printing technology in orthopedic clinical teaching [J]. Continuing medical education 5: 30-2.

10. Qiu Shaodong, Yang Kaijie, Wen Kun, et al. (2019) Application of 3D printing technology in the treatment of old pelvic and acetabular fractures [J]. Chinese Journal of orthopedics 27: 496-500.

11. Zhang Guoming, Zhou Dongsheng, he Yu, et al. (2016) Application of 3D printing technology in the treatment of complex acetabular fractures [J]. Chinese Journal of orthopedics and trauma 18: 306-11.