

Feasibility and Value of Radiographic Union Score Hip Fracture after Treatment with Intramedullary Nail of Stable Hip Fractures

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ABSTRACT

Introduction: Given the importance of fracture healing on patient outcome in clinical practice, it is critical to assess fracture healing. **Aim:** The aim of this study was to evaluate the feasibility of the Radiographic Union Score Hip fracture after treatment with intramedullary nail of stable hip fractures. **Patients and Methods:** We retrospectively collected the data from the clinical records of our institution of the 47 patients who had undergone intertrochanteric hip fracture treatment using an intramedullary nail. Pain visual analogic score (VAS) was collected the same day that X-rays were taken. Plain hip X-rays were performed, in two radiographic views, at 40 and 90 days after the surgical procedure. The correlation between the RUSH and VAS score was evaluated. **Results:** Mean RUSH and VAS scores showed a strong statistical improvement between the 40 and 90 day follow-ups. RUSH value at 40 days fitted an inverse linear regression with VAS, p-value of 0.0063 and r2 of 0.15. At 90 days the regression between RUSH and VAS scores was not significant. **Conclusion:** RUSH could be proposed as an objective system to evaluate union in hip fractures treated with intramedullary nail.

Keywords: Radiographic Value, RUSH, Intramedullary Nail, Stable Hip Fractures, Union, Non Union, Delay Union.

1. INTRODUCTION

Hip fractures (HF) have high rates of morbidity and mortality (1-3), and are prone to delayed unions and non-unions (4). HF accounts for a significant part of direct medical costs to the community and are usually associated with osteoporosis (5) although pathological fractures associated with breast, prostatic or renal tumors metastasis are also frequent (6-9).

Given the importance of fracture healing on patient outcome in both clinical practice and in guiding patients' follow-up decisions, it is critical to ensure assessments of fracture healing are reliable and valid. The assessment of fracture healing is highly subjective and lacks a gold standard, resulting in the absence of a univocal definition of fracture union (10).

The lack of consensus with regard to the definition of fracture-healing in the current orthopedic and radiological literature, has led to the development of union scores that can be applied when reading plain X-rays (11). The RUST scoring system appeared to be a reliable

tool for the evaluation of clinical outcomes and in the management of tibial fractures (11). Similarly, the RUSH score was applied in HF increasing the agreement between orthopedic surgeons and radiologists with regard to fracture healing assessment, and offering a systematic approach which may aid in the treatment and clinical practice used with patients suffering from HF (12, 13).

2. AIMS

The aims of this study were therefore: to evaluate the feasibility of the RUSH score in hip fractures treated with intramedullary nail; and to evaluate the correlation of the RUSH score to the clinical outcome.

3. PATIENTS AND METHODS

Between May and December 2015, a total of 250 patients were surgically treated in our institution for intertrochanteric fractures. Only those patients with stable fractures according to Evans classification were enrolled; in addition, enrolment required the avail-

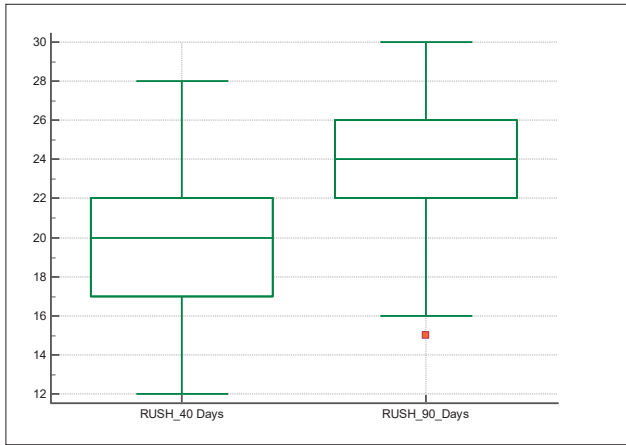


Figure 1. Mean RUSH score at 40 and 90 days after intramedullary nail positioning

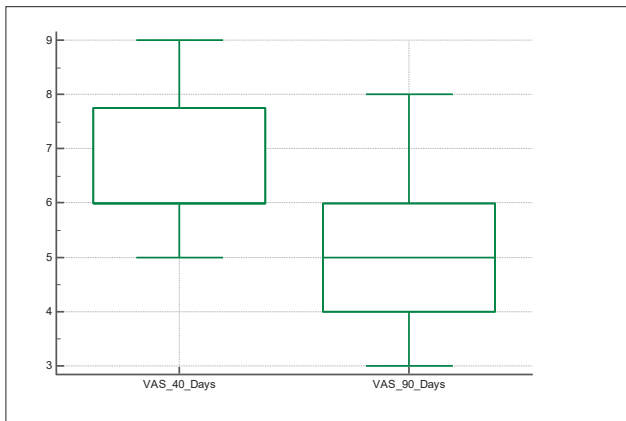


Figure 2. Mean VAS score at 40 and 90 days after intramedullary nail positioning

	40 days	90 days	p-value
RUSH (mean)	19,8	23,9	<0,0001*
VAS (mean)	6,6	5,2	<0,0001*

*paired sample T student's test

Table 1. The difference of mean VAS score at 40 and 90 days

ability of plain hip X-rays, in two radiographic views, at 40 and 90 days after the surgical procedure.

We retrospectively collected the data from the clinical records of our institution of the 47 patients who had undergone intertrochanteric hip fracture treatment which provided the positioning of an intramedullary nail (Supernail GT, Lima Corporate, Italy). Patient ages ranged from 56-94, with a mean of 83; 9 patients were male and 38 were female.

Two readers utilized the RUSH score provided by Chiavaras et al (12) and derived from the RUST scoring system. RUSH provides four component scores of cortical bridging, cortical disappearance, trabecular consolidation, and trabecular disappearance. Each component can be scored from 1 to 3. Similarly, the two trabecular indices were scored from 1 to 3, each based on consolidation for one of the indices, and fracture line disappearance for the other. The overall RUSH score therefore ranged from a minimum of 10 to a maximum of 30.

Images were reviewed separately and consensus was achieved after a second look in cases of scoring disagreement. Pain visual analogic score (VAS) was collected the same day that the X-rays were taken.

Descriptive statistics were calculated for all variables eval-

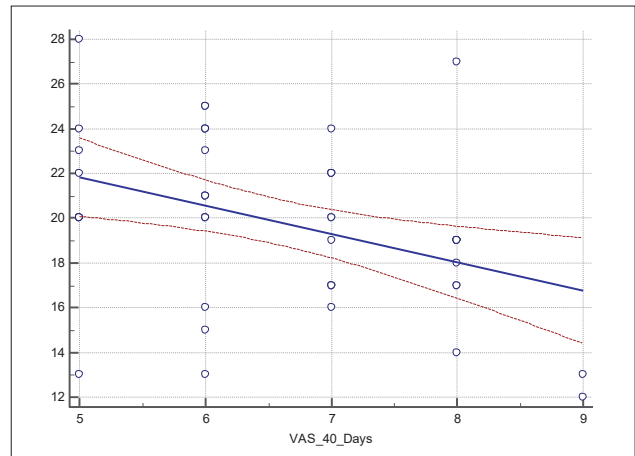


Figure 3. Regression between RUSH and VAS score at 40 days after intramedullary nail positioning.

uated at CT-E, reporting raw numbers, frequencies and averages. The T Student's test were used to test for significant differences between continuous variables. Regression between VAS and RUSH was evaluated. MedCalc Statistical Software version 14.8.1 (MedCalc Software bvba, Ostend, Belgium) was used for statistical analysis.

4. RESULTS

All 47 patients underwent intramedullary nail positioning. Thirty patients had a right intertrochanteric fracture, while 17 were left sided. Mean Rush at 40 days was 19.8 points and 23.9 at 90 days; the difference was statistically significant with a p value of less than 0.0001 (Figure 1). As well, the difference of mean VAS score at 40 and 90 days was statistically significant with a p value of less than 0.0001 (Figure 2), and a mean respectively of 6.6 and 5.2 (Table 1).

RUSH value at 40 days fitted an inverse linear regression with VAS, p-value of 0.0063 and r^2 of 0.15 (Figure 3). At 90 days the regression between RUSH and VAS scores showed a p value of 0.059.

5. DISCUSSION

Intertrochanteric fractures represent a major concern in elderly people, especially in women. The development of fixating tool has significantly improved the outcome of such patients in the last century. Nevertheless, there is still a significant variability in the assessment of fracture-healing in orthopedic trauma studies (10). Fracture healing is a frequented point outcome in orthopedic research trials; therefore, differing and subjective accounts of fracture healing can dramatically affect the perceived efficacy of a treatment (14).

The RUSH checklist improves the consistency and reliability of plain X-ray interpretation, as well it increases the utility of hip fracture radiographs.

RUSH appeared to be a feasible scoring system when applying it to intertrochanteric hip fractures treated with intramedullary nail. Actually, the cortical/trabecular bridging and disappearance were easy to assess in both the radiographic views. The only case where there may be difficulty is the evaluation of the lateral cortical bone; in this type of case the cephalic screw can hide the bridging and the fracture line. In such cases we suggest to lean for an intermediate value (2 points in the RUSH score). The significant improvement of

RUSH during follow-up seemed to reflect the union of fractures (12).

The significant correlation between RUSH and VAS scores confirms the efficacy and feasibility of the RUSH scoring system in predicting bone healing during patient follow-up. Moreover, this study forms the basis for further studies confirming the clinical value of such radiographic scoring systems, which could be used to predict patients' outcome giving to the orthopaedic surgeon a new tool in pain evaluation and follow-up. RUSH could be proposed as an objective system to evaluate union in many different fractures, including in cases that are treated with metallic fixating devices.

6. CONCLUSION

This study has several limitations: the small number of patients enrolled at one institution; and the retrospective nature of the study. The small number of patients does not allow for a proper evaluation of correlation. Moreover, the VAS scoring system is not validated to represent fracture healing. For all these reasons, further studies are required to define the correct role of RUSH.

This leads us to conclude that increasing the use of blinded assessment of outcomes and improved reporting of reliability of subjective end points will improve the quality of inferences derived from clinical studies. In the future, there will be a need to incorporate objective, quality-of-life, and functional parameters into the development of a more standardized definition for fracture union that better characterizes the chronological process of healing.

- **Author's contribution:** Daniele Maiettini, Michele Bisaccia, Auro Caraffa, Giuseppe Rinonapoli, Luigi Piscitelli, Olga Bisaccia, Giuseppe Rollo, Luigi Meccariello, Paolo Ceccarini and Alberto Rebonato disclose any financial and personal relationships with other people or organisations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding.
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- **Human and animal rights:** For this type of study no statement relating to studies on humans and animals is required.

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