

## Correspondence and author's reply

**Immediate primary skin closure in type-III A and B open fractures: results after a minimum of five years.** S. Rajasekaran, J. Dheenadhayalan, J. Naresh-Babu, et al. J Bone Joint Surg [Br] 2009;91-B:217-24.

### Letter from V. V. NarayanaRao

*Sir,*

The authors' results have clearly proved the safety of immediate primary skin closure in selected open injuries. However, there are two concerns:

- 1) We need to know the authors' definition of IIIA and IIIB injuries as it is now commonly believed that IIIB injuries should not be closed. This needs more clarification, as there are many definitions of Gustilo's classifications in the current literature.
- 2) The authors state that the "ability to close the wound without tension" is a critical factor. A Ganga Hospital skin score of 1 and 2 would mean that the selected wounds would have no skin loss, irrespective of their size, and hence this would be an inclusion criterion. However, they have also included the total score of less than 10 as additional inclusion criteria. Can this be verified?

This paper has improved our management of open injuries by defining the indications and contra-indications of this controversial procedure. While congratulating the authors for this valuable contribution to literature, we would also be grateful for clarifications regarding the above concerns.

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## Letter from C. A. M. F. de Carvalho

*Sir,*

I do not agree with the authors' statement that G-IIIB are suitable for direct skin suturing, even without tension, because, according to the Gustilo classification of open fractures, such lesions leave a defect that needs a flap to be closed.<sup>1</sup>

Gustilo and colleagues also wrote that "After debridement and irrigation are completed, a segment of bone is exposed and a local or free skin flap is needed for coverage."<sup>2</sup>

In my opinion, all cases included in this study must be reclassified as G-IIIA.

I would appreciate the authors' comments.

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**1. Gustilo RB, Mendoza RM, Williams DN.** Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma* 1984;24:742-6.

**2. Gustilo RB, Merkow RL, Templeman D.** The management of open fractures. *J Bone Joint Surg [Am]* 1990;72-A:299-304.

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## Letter from B. A. Akinola

*Sir,*

We read this paper with interest. Primary skin closure of type III open fractures is being undertaken more often, dependent on local conditions, and we commend the authors for their valuable contribution to this issue. We note that their results are equivalent to

outcomes for Type IIIA open fractures as reported in the literature. However, we find the title misleading.

By classification, a Gustilo and Anderson type IIIB fracture is not amenable to immediate primary closure. The original paper<sup>1</sup> classified open fractures into three categories, namely: type I, type II, and type III. The designation of type III was later subdivided, in order of worsening prognosis, into types IIIA, IIIB, and IIIC.<sup>2</sup> Type IIIB, by definition, represents extensive soft-tissue injury loss with periosteal stripping and bone exposure.<sup>2</sup> Dr Gustilo later clarified a type IIIB injury as one in which the use of local or free vascular flaps is essential.<sup>3</sup> It follows then, that strictly speaking, immediate primary closure of open fractures is impossible for a type IIIB injury. Therefore the photographs shown on page 222 can only qualify as a type IIIA injury since there was adequate skin cover left for immediate primary closure following fracture stabilisation.

The point was made by Dr Gustilo that their classification system is preliminary at the time of the initial presentation, and final grading should be done only after debridement and irrigation has enabled the surgeon to determine what kind of soft-tissue reconstruction is needed.<sup>3</sup> The limitations of the Gustilo-Anderson system have been recognised by others,<sup>4,5</sup> and it would be interesting to see whether the authors' Ganga hospital classification system could be introduced to the orthopaedic world as an alternative.

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**1.Gustilo RB, Anderson JT.** Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. *J Bone Joint Surg [Am]* 1976;58-A:453–8.

**2.Gustilo RB, Mendoza RM, Williams DN.** Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma* 1984;24:742-6.

**3.Gustilo RB.** Interobserver agreement in the classification of open fractures of the tibia. The results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1995;77-A:1291–2. [Letter to the Editor.]

**4.Brumbach RJ, Jones AL.** Interobserver agreement in the classification of open

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fractures of the tibia: the results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1994;76-A:1162–6.

**5.Brumbach RJ, Jones AL.** Interobserver agreement in the classification of open fractures of the tibia. The results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1995;77-A:1291–2. [Letter to the Editor: Authors' reply.]

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## Letter from D. J. Rolton

*Sir,*

We read this paper with interest in which the authors describe the primary closure of grade-IIIB open fractures.

The classification of these fractures is based on the degree of soft tissue injury. The original Gustilo Anderson classification states that grade III injuries are 'characterized by extensive soft tissue loss, instability, and large areas of exposed bone requiring soft-tissue coverage'.<sup>1</sup> Grade III injuries were later subdivided with grade IIIB injuries described as exhibiting extensive soft tissue loss, periosteal stripping and exposure of bone.<sup>2</sup> Gustilo has further stated that the treatment of grade IIIB injuries with free or local flaps is essential.<sup>3</sup> The high degree of interobserver variation in reporting these types of injuries has been well documented.<sup>4</sup> The time at which these injuries are classified is also key as the true degree of soft tissue injury can only be confirmed once an adequate debridement has been performed.<sup>3</sup>

The authors state that there were difficulties in classifying the injuries into IIIA and IIIB as 'there is no longer a uniformly accepted definition.' The study group implemented their own scoring criteria (The Ganga hospital open injury score) for excluding those with large amounts of tissue damage post debridement.<sup>5</sup> Whilst there are discrepancies in the current classification the new scoring criteria proposed needs further validation. The published literature supports that grade IIIB injuries are not amenable to primary closure and require additional soft tissue procedures. The findings in the paper would have been more relevant if the authors had detailed separately the individual numbers and outcomes for IIIA and IIIB injuries rather than grouping them together. We would also like to know the authors' own definition for classifying patients as grade IIIB, thereby allowing them to be included in this study.

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- 1. Gustilo RB, Anderson JT.** Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. *J Bone Joint Surg [Am]* 1976;58-A:453-8.
- 2. Gustilo RB, Mendoza RM, Williams DN.** Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma* 1984;24:742-6.
- 3. Gustilo RB.** Interobserver agreement in the classification of open fractures of the tibia: the results of a survey of two hundred and forty- five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1995;77-A:1291-2. [Comment]
- 4. Brumback RJ, Jones AL.** Interobserver agreement in the classification of open fractures of the tibia: the results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1994;76-A:1162-6.
- 5. Rajasekaran S, Naresh Babu J, Dheenadhayalan J, et al.** A score for predicting salvage and outcome in Gustilo type-IIIA and type-IIIB open tibial fractures. *J Bone Joint Surg [Br]* 2006;88-B:1351-60.

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## Letter from S. Ibrahim

Sir,

I read this paper with concern. The clinical photograph (Fig. 3e) showed primary skin closure, but this appeared to be under tension and healing resulted in a broad scar. Furthermore, while 143 patients had primary wound healing, 26 patients had marginal wound necrosis not requiring surgical intervention, one had wound necrosis requiring debridement and secondary suturing, and three required debridement and flap cover. Is primary skin closure justified considering that 30 patients subsequently had problems with wound necrosis? Although the wounds may have been closed without

tension initially, subsequent oedema would have resulted in the sutures constricting the skin edges resulting in ischaemic necrosis.

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### Authors' reply:

*Sir,*

We thank Dr de Carvalho, Dr Akinola, Dr Rolton, Dr NarayanaRao and Dr Ibrahim for their interest in our paper on 'Immediate primary skin closure in type-III A and B open fractures'. The concern expressed by them is common and related to the exact definition of Type III A and III B injuries and whether III B injuries can be closed. We would like to discuss this important issue in greater detail and clarify our opinion in this frequently debated issue.

In Gustilo's original description,<sup>1</sup> a III B injury was defined as 'extensive soft tissue injury loss with periosteal stripping and bony exposure. This is usually associated with massive contamination'. The emphasis here was on the nature of injury to the tissue components and there was no mention about the nature of treatment required. This was the basis of classification of the injuries in our series into III A or III B. There is, however, a current trend of defining a III B injury as one that requires a soft tissue flap. This definition is frequently presented, described in the literature and taught with authority but it is unclear who should be credited or discredited for this transformation. As mentioned by Carvalho, Gustilo et al<sup>2</sup> subsequently indicated that III B injuries may require soft tissue cover but did not emphasise that as the main criteria for differentiation between III A and III B injury. To define a III A injury as one that can be closed, and a III B injury as one that requires a flap, ignoring other characteristics of

injury, would do Gustilo's classification a serious injustice by denigrating it to a 'retrospective classification'.

We have strong objections to classifying a IIIB injury depending on the type of soft tissue cover given for the following reasons:

1. Any classification is useful only if it is prospective, provides guidelines in management and helps to compare the outcomes of different methods of treatment.<sup>3</sup> This essentially means that Gustilo's classification must guide management of an open injury. It would be meaningless if wounds are classified at the end of the treatment depending upon the soft tissue reconstruction.
2. In Gustilo's own words,<sup>2</sup> his classification may change from the time of presentation to debridement depending upon the amount of debridement required for the skin and soft tissues. In many patients who have wound necrosis, skin grafts or flaps are performed after an interval of days or weeks. This would mean that many wounds may remain unclassifiable until a few weeks after injury.
3. The indications and use of a flap are not universal and vary widely in different trauma centres even in the same country. The performance of flaps is as dependent on the availability of expertise and manpower as it is on a scientific basis. It is common knowledge that large wounds treated by immediate primary closure in a unit like ours (Fig. 1) may be treated by a flap in other units. If the performance of a flap is the criteria for IIIB, the classification becomes surgeon and unit dependent, further reducing the value of the classification.
4. The techniques of soft tissue reconstruction and the indications for a flap have changed and will continue to change over the years with the development of new techniques and technologies. So the basis of a IIIB wound will change continuously, making it impossible to compare the results of similar injuries at different periods of time treated by different techniques.
5. Many centres widely use bipedicle fasciocutaneous closure with relaxing incisions and slow stretching skin approximation techniques for gaping wounds that cannot be closed initially. Would these wounds be considered as IIIA or IIIB?

It is clear that the characteristics of the injury should be the basis of differentiating IIIA and IIIB and not the method of soft tissue treatment. Wounds shown in the two examples (Figs 1 and 2) clearly illustrate our points further. Both these wounds are extensive, with exposure of fracture surfaces, have periosteal stripping and would surely be classified as IIIB at presentation in most centres. They would also probably be treated by debridement and skeletal fixation followed by a staged soft tissue flap. Our main purpose was to show that it is possible to adopt a policy of immediate closure even in these injuries if the inclusion criteria that we have proposed are met. In our opinion, to

argue whether these injuries are IIIA or IIIB because they did not have a flap is inappropriate.

Dr Rolton has suggested that it would have been better if we had reported the results separately for IIIA and IIIB injuries. We feel that this would not have been useful as many definitions of Gustilo's classification are in current use and it is often impossible to rigidly classify many of these wounds into either IIIA or IIIB. The descriptive nature of Gustilo's classification allows ample opportunity for subjective error, making it impossible to get a good interobserver agreement. Brumback and Jones have demonstrated that the average interobserver agreement for Gustilo's classification is only 60% and the overall agreement for each fracture may range from 42% to 90%. Many authors have echoed the need for a more precise and reproducible system, based on objective criteria.<sup>4,5</sup> Thus we decided not to identify the wound as IIIA or IIIB but to use the skin and total Ganga Hospital Open Injury Severity Score for the inclusion and exclusion criteria.

Dr NarayanaRao asks why both the skin score and the total score of Ganga Hospital Open Injury Scoring System<sup>6</sup> are inclusion criteria. A skin score of less than three indicates that irrespective of the size and location of the wound, it would be closable as there is no loss of the skin. Wounds with a total score of greater than ten indicate a limb with a high energy violence with damage to many of the tissue components. This represents a situation where the zone of injury may not be exactly definable during the initial debridement and also the possibility of progressive local swelling and oedema during the first 48 to 72 hours. This would be a contraindication for a primary closure as it may lead to wound breakage and necrosis. Thus a total score of ten and above is an exclusion criterion for primary closure.

The ultimate challenge in these injuries is to prevent infection and attain union preserving maximum function. The challenge comes from the severity of the injury which includes periosteal stripping, bony comminution and loss or damage to musculotendinous units. This is common knowledge to all surgeons who are involved in the management of these complex injuries and they would agree that these criteria must form the basis of classification of an injury rather than whether a flap was required or not.

We strongly urge the orthopaedic community to stay with the original classification of Gustilo<sup>1</sup> and classify wounds according to the severity and nature of the wound and not on what treatment is felt to be required at some arbitrary point in time.<sup>7</sup> This would help to keep Gustilo's classification meaningful and internationally applicable. Making

the requirement of a soft tissue procedure as the main criteria for IIIB injuries would render Gustilo's classification essentially a useless retrospective exercise. The

classification would also become surgeon and institution dependent and would lose its ability to compare different forms of treatment over different periods of time.

Gustilo's contribution was a milestone in our understanding of the importance of the soft tissue damage, periosteal stripping, contamination and the force of the injury to the outcome of open injuries. It is, however, too subjective, has a poor rate of agreement amongst surgeons and has many modified versions. It is time for better scoring systems which are based on more objective criteria. In our experience, the Ganga Hospital Open Injury Severity Score<sup>6</sup> is not only more reliable but is also useful to prognosticate outcome and choose the appropriate limb salvage pathway.<sup>8</sup>

We are grateful for the opportunity to express our views on this controversial issue and thank the authors for their interest and views on our paper.

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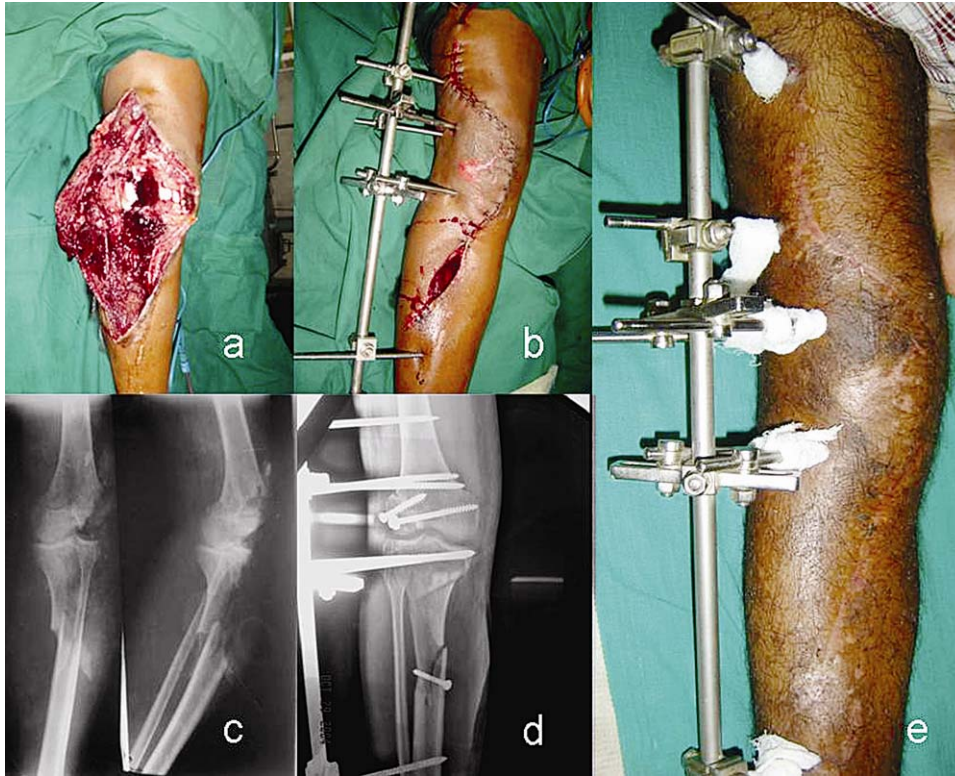
## References

- 1. Gustilo RB, Mendoza RM, Williams DN.** Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma* 1984;24:742-6.
- 2. Gustilo RB.** Interobserver agreement in the classification of open fractures of the tibia. The results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1995;77-A:1291-2. [Letter to the Editor.]
- 3. Burstein AH.** Fracture classification systems: do they work and are they useful? *J Bone Joint Surg [Am]* 1993;75-A:1743-4.
- 4. Brumback RJ, Jones AL.** Interobserver agreement in the classification of open fractures of the tibia: the results of a survey of two hundred and forty-five orthopaedic surgeons. *J Bone Joint Surg [Am]* 1994;76-A:1162-6.

5. **Horn BD, Rettig ME.** Interobserver reliability in the Gustilo and Anderson classification of open fractures. *J Orthop Trauma* 1993;7:357-360.
6. **Rajasekaran S, Naresh Babu J, Dheenadhayalan J, et al.** A score for predicting salvage and outcome in Gustilo type-III A and type-III B open tibial fractures. *J Bone Joint Surg [Br]* 2006;88-B:1351-60.
7. **Anglen J.** Classification of type III B open fracture. *J Orthop Trauma* 2007;21:422; author reply 422-3.
8. **Rajasekaran S, Sabapathy SR.** A philosophy of care of open injuries based on the Ganga hospital score. *Injury* 2007;38:137-46.

## Figures

Figure 1



A 24 x 10 cm wound over the front of the thigh, knee and leg exposing the fracture and the knee joint. The extensive comminution for bones, periosteal stripping and soft tissue damage are obvious. There is no doubt that this is a IIIB injury by Gustilo's original classification. The purpose of our paper is to show that even such injuries can be treated by immediate primary closure if all inclusion criteria mentioned in our paper are met.

Figure 2



An extensive wound on the medial side of the leg exposing the fracture and the adjacent tibia. There is also periosteal stripping. This wound will be classified typically as IIIB in many centres and may be treated by debridement, temporary skeletal stabilisation and soft tissue reconstruction. However, the wound satisfied our inclusion criteria for primary closure and was treated successfully by immediate primary closure. It would be the wrong policy to downgrade the severity of the injury to IIIA because of the protocol of treatment.