50 Years Ago in CORR

Function Fixation of Femoral Neck Fractures; Telescoping Nail Technic

William K. Massie MD CORR 1958;12:230–255

This month's symposium is devoted to the biomechanics of fracture healing. The importance of ensuring proper mechanical conditions for fracture repair has been known since antiquity: the ancients empirically knew motion impaired healing and a certain amount of immobilization was required for healing. Sir W. Arbuthnot Lane, one of the pioneers in internal fixation (and one of whose articles we republish in this issue [2]) recognized the importance of obtaining "absolute fixation of the fragments" to "yield better results than methods which fall short of this..." [1]. A half-century later, William Massie was another pioneer in the development of fracture fixation when he introduced a sliding hip nail [3]. Massie reviewed the history of internal fixation of hip neck fractures and emphasized the two major complications: nonunion and osteonecrosis. The former related in large part to the failure to achieve proper mechanical conditions and the latter to injury to the blood supply to the femoral head either from the injury or the treatment. Early attempts at internal fixation of femoral neck fractures reduced mortality (undoubtedly by allowing patients earlier function and avoiding prolonged bedrest or casting) but did not reduce the rates of nonunion. In contrast, Massie's review illustrates the advances in operative treatment by mid-century almost always resulted in

Fig. 7 Both models are built to scale and are mounted identically in anatomic position with a femoral axis inclination of 10°. Pressure is exerted by the lever set at 165° with the vertical or 155° with the femoral shaft. Double exposure demonstrates only compression at *left*, which utilizes a sliding nail-plate appliance inserted at 155°, but at *right* a similar force applied at the identical angle against an identical "fracture line" shows shearing tendency when an appliance is inserted at less than 155° (140°). The identical component of shear is present in both models, but at *left* it is overcome by the impacting force represented, while at *right* the rigid nail opposes this impacting force and allows shear to predominate. When a plate is attached to the nail, the head can no longer drop into varus, but impaction is resisted until the nail has eroded through the cortex of the proximal fragment and penetrates the joint. (Reprinted with permission from Massie WK. Functional fixation of femoral neck fractures; telescoping nail technic. *Clin Orthop Relat Res.* 1958;12:230–255.)

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lower rates of nonunion but still did not necessarily reduce the rates of osteonecrosis. Proper treatment, he argued, depended upon obtaining, then maintaining proper alignment, apposition, and immobilization of the fragments. “*Every uncomplicated fracture should heal if optimum conditions are provided,*” he stated (*italics his*). Alignment was assured by proper reduction and he emphasized the importance of proper alignment in the frontal and lateral planes. Apposition was achieved by ensuring compression on the fracture surfaces as the inevitable resorption occurred. Immobilization required the proper mechanical conditions. The ability to achieve these latter two goals depended upon the design of an internal fixation device.

Massie introduced several key design changes to achieve proper apposition and immobilization. The first was a telescoping nail which would allow the inevitable settling of the fracture with resorption. Thus, compression was constantly maintained. The second was a high angle nail (155°) corresponding to the

direction of the frontal plane loads on the hip (Fig. 7 from his article). Traditional hip nails were implanted along the neck-shaft angle, which was 20–30° less than the direction of loading. Placing the nail in the direction of loading, he argued, would “*resist an angular stress which would tend to prevent telescoping of the nail by increasing the friction between the nail and the nail sleeve*” (*italics his*). The high angle nail would also correspond to the natural direction of the bony trabeculae; “shear” across the fracture site (see Fig. 7), he concluded, “would be limited.” Massie compared the results using his new device in 57 patients with those from 21 patients using various traditional rigid nail-plate devices. All fractures healed in the former group and 38% had one or more complications (osteonecrosis, sepsis, nail penetration) while in the latter group 16 healed and 62% had one or more complications. While the complication rate seems high by contemporary standards, one must interpret those findings in the context of even higher rates of complications

in previous reports. The high-angle telescoping nail indeed reflected a marked advance recognizing the crucial role of mechanics in fracture healing.

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References

1. Lane WA. *The Operative Treatment of Fractures*. London, England: The Medical Publishing Company, Ltd; 1905.
2. Lane WA. The operative treatment of fractures. *Ann Surg*. 1909;50:1106–1113.
3. Massie WK. Functional fixation of femoral neck fractures; telescoping nail technic. *Clin Orthop Relat Res*. 1958;12:230–255.

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