A Simple 3-Dimensional Printed Aid for a Corrective Palmar Opening Wedge Osteotomy of the Distal Radius

Philipp Honigmann, MD,*†‡ Florian Thieringer, MD, DDS,‡§ Regula Steiger, MD,* Mathias Haefeli, MD,‖ Ralf Schumacher,¶ Julia Henning, MD*

The reconstruction of malunited distal radius fractures is often challenging. Virtual planning techniques and guides for drilling and resection have been used for several years to achieve anatomic reconstruction. These guides have the advantage of leading to better operative results and faster surgery. Here, we describe a technique using a simple implant independent 3-dimensional printed drill guide and template to simplify the surgical reconstruction of a malunited distal radius fracture. *(J Hand Surg Am. 2016;41(3):464–469. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Distal radius mal-union, corrective osteotomy, virtual planning, 3-dimensional printing, drill guide.

Surgical Technique

INTRODUCTION AND INDICATION

Corrective osteotomies of malunited distal radius fractures are often challenging. The main focus of the intervention lies in the anatomic restoration of (a) the joint surface, (b) radial length, and (c) palmar tilt. Changes of carpal kinematics, and loss of function such as grip strength, and early onset of osteoarthritis need to be prevented.[1–4] To achieve this, the intervention must be planned and performed precisely. Use of customized drill and resection guides using 3-dimensional printing has become more popular since the late nineties.[5–7] Using guides to place Kirschner wires or to directly guide the osteotomy facilitates the operative procedure.[8,9] Furthermore, their use enables accurate translation of what is planned preoperatively to the results obtained intraoperatively.

FDA-approved materials such as acrylate, nylon, and titanium have been used to fabricate surgical guides. In knee prosthetic surgery, commercialized drill and resection guides made of sintered nylon have been used since 2009 (My Knee, Medacta, Castel San Pietro, Switzerland). Several authors, Daniilidis and Tibesku[10] and Chotanaphuti et al,[11] have studied the accuracy of their use. Recently, Fürnstahl et al[12] published preliminary results using an acrylate drill guide for the correction of intra-articular tibial plateau malunions.

In hand surgery, the concept of planning a drill device using CAD (computer aided design) software for corrective osteotomies of the distal radius has been published by Kunz et al,[9] who used the predrilled template-guided drill holes to achieve planned alignment. This concept has been further advanced and used to fix distal intra-articular radius malunions using patient-specific drill and resection guides.[8]

Specialist instruments such as the AO-distractor (Synthes, De Puy Synthes, Oberdorf, Switzerland) or Hintermann-distractor (Integra LifeSciences Corporation, Plainsboro, NJ),[13] have been used to facilitate the operative procedure. These instruments are of particular importance when performing palmar

*From the *Department of Hand Surgery, Kantonsspital Baselland, Liestal; the †Clinic for Plastic, Reconstructive, Aesthetic and Hand Surgery, University Hospital of Basel; the ‡Medical Additive Manufacturing Research Group, Department of Biomedical Engineering, University of Basel; the §Department of Oral and Cranio-Maxillofacial Surgery, University Hospital of Basel, Basel; the ‖Department of Hand Surgery, Kantonsspital Baden, Baden; and the ¶University of Applied Sciences and Arts Northwestern Switzerland, Basel, Switzerland.*

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Corresponding author: Philipp Honigmann, MD, Department of Hand Surgery, Kantonsspital Baselland Liestal, Rheinstrasse 26, 4410 Liestal, Switzerland; e-mail: philipp.honigmann@ksbl.ch.

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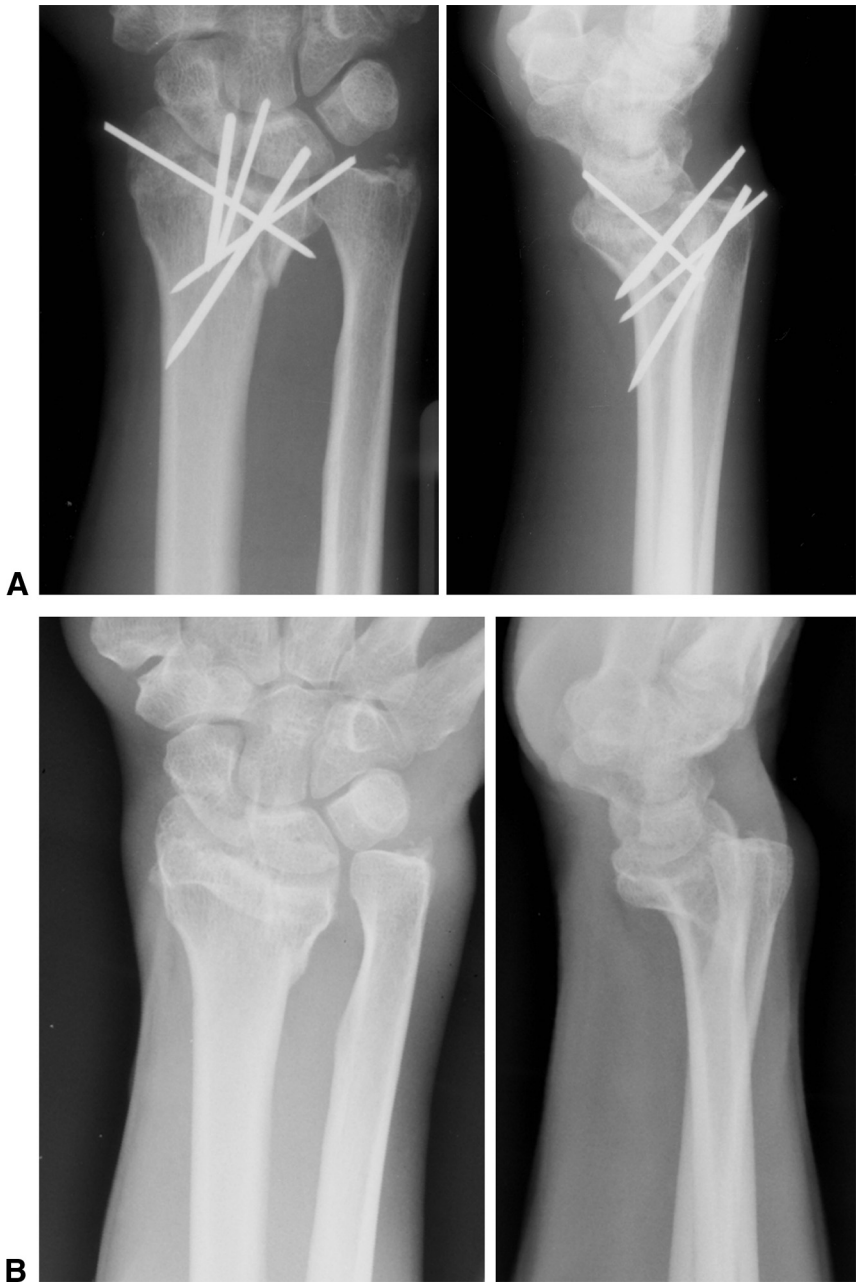

FIGURE 1: A Three months postoperatively after initial treatment. **B** Anteroposterior and lateral x-ray view of the malunited intra-articular distal radius fracture 1 year after initial treatment.

extra-articular open wedge corrective osteotomies. In these cases, the osteotomy needs to be distracted to permit the placement of an iliac crest wedge into the gap. A major drawback of using these instruments, however, is that correct assessment of the position of reconstruction may be hard to judge because of the radio-opacity of the instruments. A radiolucent tool can overcome this and would simplify the verification of the correct reconstruction.

We present a technique using a preoperatively designed simple 3-dimensional-printed patient-specific radiolucent drill guide and wedge for the extra-articular correction of a malunited distal radius fracture. By incorporating a wedge into the design, an accurate template can be used to facilitate harvesting of the iliac crest bone graft.

SURGICAL TECHNIQUE AND CLINICAL CASE

A 54-year-old man sustained an intra-articular distal radius fracture (AO-Classification AO 23 B3)[14] of his dominant right wrist. The fracture had been previously treated with percutaneous Kirschner wires (Fig. 1A). By the time the patient presented to us, the