Orthotics and Prosthetics, Volume 38, Number 3, Autumn, 1984, pp. 63–68.

"Zero-Position" Functional Shoulder Orthosis for Postoperative Management of Rotator Cuff Injuries

Jiro Ozaki, M.D.
Ichiro Kawamura

INTRODUCTION

Many shoulder orthoses such as the airplane splint, the abduction splint, and the Velpeau bandage have been widely used for injuries. These orthoses, however, sometimes cause shoulder contracture and muscle imbalance. The shoulder joint possesses the widest range of motion and the most varied movements of any joint in the human body. The "scapular plane" has been accepted as the reference plane for the mechanism of the shoulder joint[2] (Figure 1). Codman (1934)[1] pointed out a very natural position for the human arm when the body is recumbent, and called this position a subordinate pivotal position. In this position, the axis of the humerus is in line with the axis of the spine of the scapula, and the head and the neck of the humerus is in the same plane (Figure 2). Saha (1961)[5] has designated this point as the "zero-position," because muscular rotatory forces acting upon the humerus at this position are almost zero. Ozaki (1980)[4] performed cineradiographic and radiographic studies, and concluded that the scapular plane should be inclined forward at an angle of 30 to 45 degrees to the frontal plane, and that in the zero-position the humerus must be elevated to 150 degrees in the "scapular plane," with individual variations. On the basis of these biomechanical concepts, we designed our zero-position functional shoulder orthosis for the postoperative management of rotator cuff injuries.

FABRICATION PROCEDURE

The orthosis consists of a pelvic support, a thoracic support, an upright bar, and an arm support (Figure 3). The pelvic girdle is made of 4mm subortholene plastic sheet. The iliac crest is the most important point of this orthosis—if the upright support fails to hold the shoulder in position after it is fitted to the patient, it will result in serious problems for the shoulder joint. The length of the upright bar can be changed because the distance from axilla to iliac crest varies according to the angle of elevation and depression of the arm. The up-

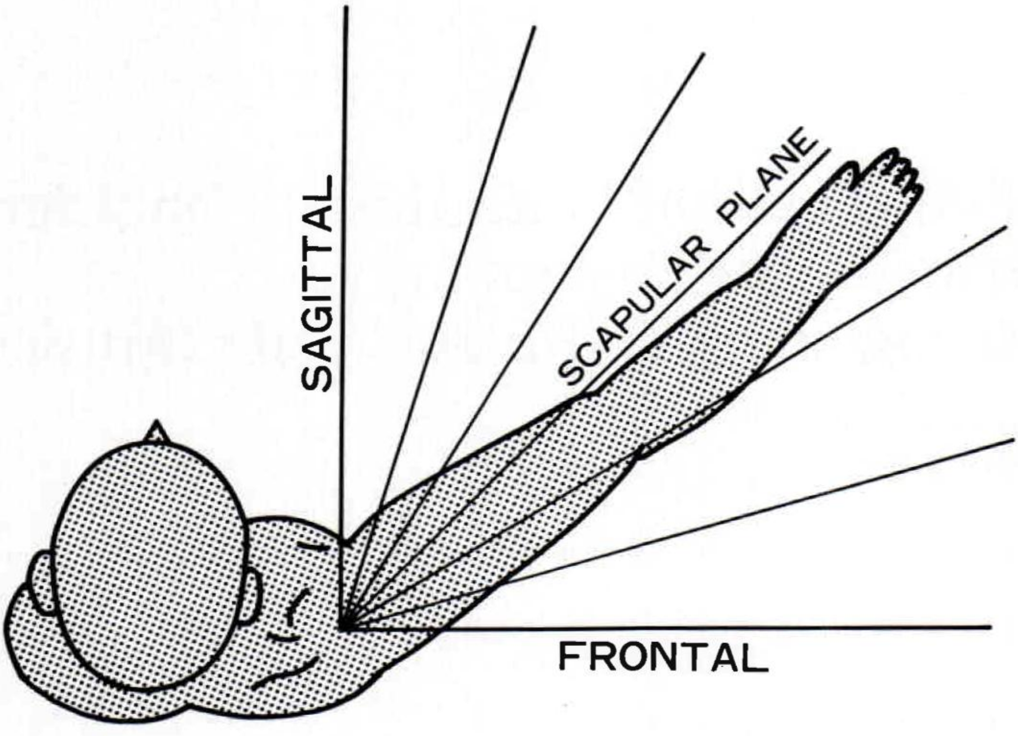

Figure 1. The scapular plane.

right bar can be rotated on a horizontal plane and fixed in any position. The elevation angle of the shoulder joint can be changed by a mechanical joint and it can be fixed in any position. The distance of axilla to elbow joint changes when the shoulder joint is lowered so it also has to be adjustable. The angle of internal and external rotation of the humeral axis is very important for the zero-position. For a relaxed position, the shoulder has to take a neutral position; therefore, we have provided a rotation mechanism. The angle of the elbow joint is also important for a relaxed position. It should be flexed slightly. At this joint, the angle of flexion can be changed and fixed in any position and the lower arm support can be removed when necessary for exercising the forearm.

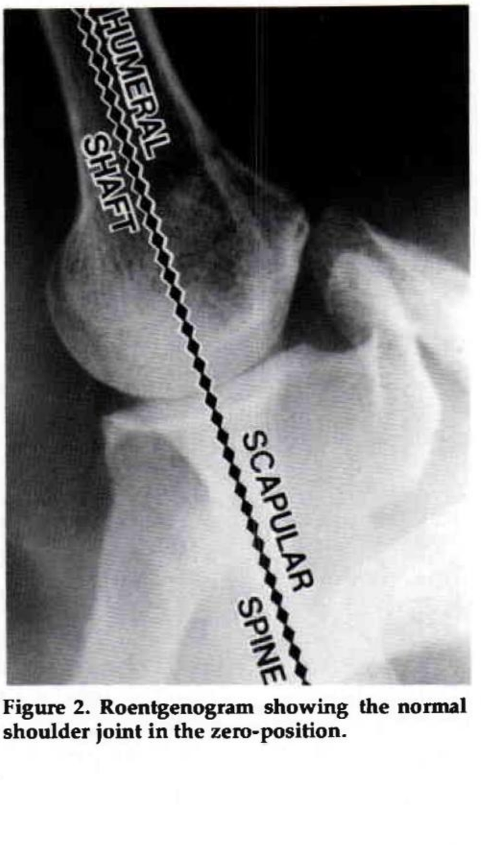

Figure 2. Roentgenogram showing the normal shoulder joint in the zero-position.

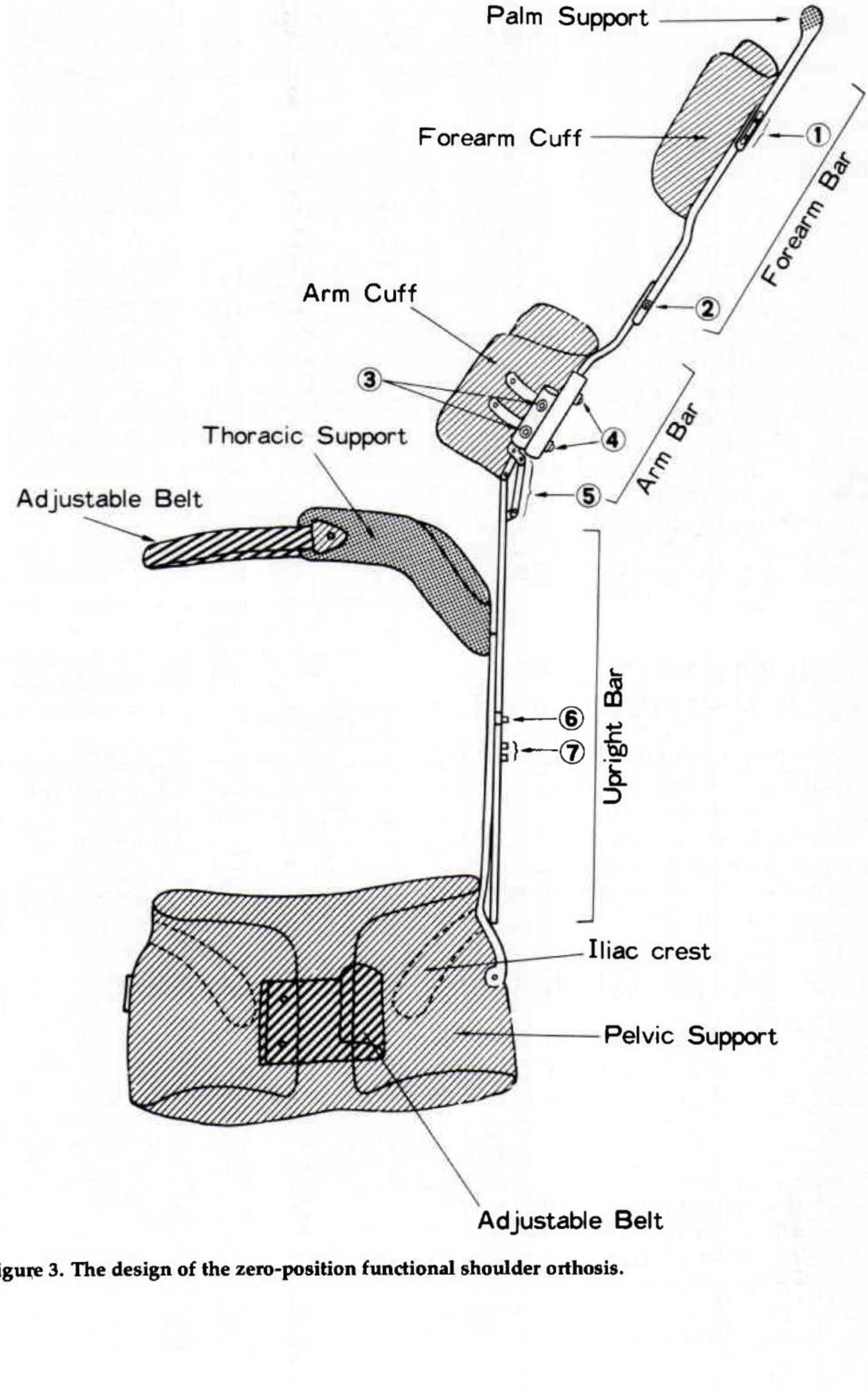

Figure 3. The design of the zero-position functional shoulder orthosis.

THE CASTING PROCEDURE

The plaster negative should be made before the operation because the orthosis must be fitted to the patient after only a few days and it is difficult to make the cast after the operation.

The casting should be made from the metacarpal phalangeal joint of the hand to the pelvic girdle in the zero-position. As we pointed out, the most important point of this orthosis is the iliac crest, so be careful to create the proper shape for this area in making the plaster negative.

The arm should be elevated to 150 degrees and flexed forward 30 to 45 degrees from the frontal plane. The palm of the hand should face inwards to give neutral rotation of the humerus, and the elbow joint should be slightly flexed to give a more relaxed position of the shoulder joint.

If it is impossible to make the plaster negative for some reason, fit the patient using the Boston Brace™ body jacket or something similar.

MODIFICATION OF THE PLASTER POSITIVE MODEL

For convenience of modification, provide marking at the base of the axilla and cut open the trunk part and the upper limb. The basis for ensuring zero-position is a well fitted pelvic girdle, so it must be deeply cut away in the waistline as with a Milwaukee Brace girdle.

PLASTIC LAMINATION AND FITTING

The pelvic girdle and each cuff for the upper limb are made from 4mm subortholene plastic sheet. The distal trimming line of the pelvic girdle should extend low enough posteriorly to just clear the chair when the patient sits. Proximally, it should not touch the bottom edge of the 12th ribs. The anterior distal edge of the pelvic girdle must cover the anterior superior iliac spines laterally, but medially only to the top of the symphysis pubis.

The upper arm and forearm cuffs should be trimmed so that the shoulder joint can be adducted completely and the elbow joint flexion angle is not disturbed. Fix the 5/8″ upright to the pelvic girdle and the thoracic metal band. Weld a 1/2″ diameter metal tube to the bar. Assemble each cuff for the upper limb and the shoulder joint, and then connect them to the tube. Cut off any unnecessary material as far as possible.

CLINICAL CONSIDERATIONS

Concerning shoulder immobilization after the operation for rotator cuff injuries, several methods such as Plaster of Paris spicas and the Velpeau bandages have been used, but they sometimes cause contracture of the shoulder joint. The use of the zero-position as the position for postoperative immobilization of rotator cuff injuries is not a common practice, but it is particularly helpful in the postoperative program for regaining functional movement.[3] As the zero-position tends to be a point of convergence for elevation in the scapular plane, the patient who works for greater range of motion from the zero-position is able to initiate movement readily in any plane of elevation. Furthermore, since the deltoid, the supraspinatus, and the infraspinatus are relaxed, the zero-position is the most favorable position to encourage physiological repair of lesions in and about the greater tuberosity. Also, the scapular plane is the reference plane for the movements of flexion and extension, abduction and adduction at the humeroscapular joint, and in this plane the rotator cuff is not subjected to a twisting strain. These are the reasons why we have used our zero-position functional shoulder orthosis for postoperative management of rotator cuff injuries.

™ Physical Support Systems

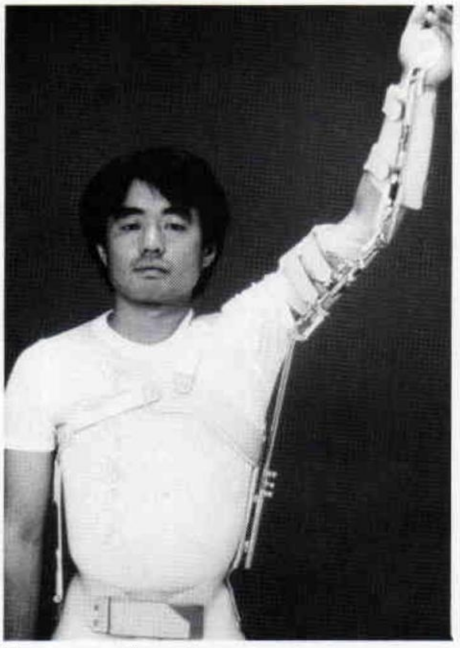

Figure 4-A. The orthosis is applied to maintain the zero-position. An anterior view.

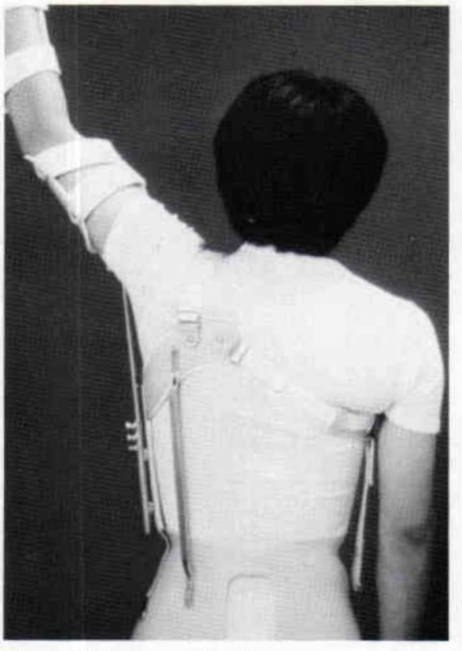

Figure 4-B. A posterior view.

POSTOPERATIVE MANAGEMENT OF ROTATOR CUFF INJURIES

Immediately after the successful repair of the rotator cuff injury, the zero-position of the shoulder should be maintained by skin traction while the patient rests in bed. After three days, the functional shoulder orthosis, which has been made to order preoperatively, is applied to maintain the zero-position on the scapular plane (Figures 4-A, 4-B). At the beginning of the third postoperative week, the upper limb in the orthosis is extended at 100 degrees abduction on the scapular plane and the patient is allowed to start gradual actively-assisted abduction exercise of the arm.

From the fourth to the sixth week, when the patient is able to perform active elevation in the range of 60 degrees to 150 degrees, the abduction angle of the orthosis can be decreased gradually to 30 degrees. Mass movement exercise involving circular motion is indicated. Two to three months after surgery, the orthosis is removed. At this stage the patient is able to use a full range of elevation, and at three to six months, the patient has made maximum recovery.

For the postoperative management of rotator cuff injuries, we have fitted this orthosis on more than 75 patients. As a result of being able to gradually decrease the elevation angle from the zero-position, it was recognized that pain which had occurred in the patients of the plaster cast immobilization group in the zero-position was reduced. Therefore, early healing and excellent results were achieved in nearly all cases.

CONCLUSION

On the basis of the biomechanical concepts of the zero-position and the scapular plane, the authors have designed this zero-position functional shoulder orthosis. It has been successfully fitted to more than 75 patients for the postoperative management of rotator cuff tears. Clinical trials of this orthosis can be extended to the postoperative management of other shoulder conditions, but in case of recurrent shoulder dislocation, posttraumatic shoulder dislocation, and inferior and multidirectional instability of the shoulder, it should not be used to immobilize at the zero-position, because glenohumeral dislocation may frequently be encountered due to glenohumeral instability such as Bankart, or Hill-Sacks lesions, and glenoid dysplasia.

NOTES

Please send reprint requests to Dr. Jiro Ozaki, M.D., Department of Orthopaedic Surgery, Nara Medical University, Kashihara, Nara, 634, Japan.

REFERENCES

[1]Codman, E.A., Boston, T. Todd, "The Shoulder," 1934.

[2]Johnston, T.B., "Movements of the shoulder joint. A plea for the use of the 'plane of the Scapula' as the humero-scapular joint," *British Journal of Surgery*, 25, pp. 252-260, 1937.

[3]Ozaki, J. and Nobuhara, K. "Postoperative management of rotator cuff injuries," Seikeigeka Mook, 4, pp. 109-116, 1978.

[4]Ozaki, J., "Shoulder mechanism," A study based on cineradiography and radiography with the arm elevated, *The Journal of the Japanese Orthopaedic Association*, 54, pp. 1679-1692, 1980.

[5]Saha, A.K., Springfield, C.C. Thomas, "Theory of shoulder mechanism," 1961.

AUTHORS

Jiro Ozaki, M.D. is on the staff of the Department of Orthopaedic Surgery, Nara Medical University, Kashihara, Nara, 634, Japan.

Ichiro Kawamura is with Kawamura Orthopaedic Appliance Co., Ltd.