

Hallux Valgus in the Elderly: Metatarsophalangeal Arthrodesis of the First Ray

Y. Tourné, M.D., D. Saragaglia, M.D., A. Zattara, M.D., J.P. Maire, M.D., F. Picard, M.D.,
E. Montbarbon, M.D., and A. Charbel, M.D.
Grenoble, France

INTRODUCTION

Metatarsophalangeal (MTP) arthrodesis of the great toe has been used to successfully treat deformations and painful stiffness of the great toe.^{5,7,18} A successful outcome is determined by several factors: (1) Pain-producing mechanisms must be eliminated by allowing the earliest possible postoperative weightbearing. (2) Stable fixation of the arthrodesis must occur. This allows improvement of the biomechanics of gait, preventing secondary interphalangeal osteoarthritis and footwear problems.

Numerous techniques include cross-pinning or the use of isolated screws, staples, or plates.^{3,5,7,9,14,22,23,25,28,32} The procedure we advocate combines a 4-mm diameter cancellous bone compression screw and a 1/4-inch tubular screwed plate.³¹

No consensus prevails on preferred angles of arthrodesis, but a valgus angle between 10° and 20° with a dorsiflexion angle from 25° to 35° seems to be biomechanically and functionally successful.

Indications for arthrodesis fall into four groups: (1) rheumatoid arthritis; (2) hallux rigidus with osteoarthritis; (3) failures of hallux valgus surgical procedures; and (4) hallux valgus in the elderly. This article discusses our experience with hallux valgus in the elderly. We recommend the specific technique because it prevents recurrence of hallux valgus deformation.

MATERIALS AND METHODS

Study Cohort

Thirty-three patients (30 women and 3 men), with an average age of 67 years (57–78 years), were included in a retrospective study representing 42 arthrodesis procedures (9 bilateral cases) that were performed between May 1982 and October 1994.

Service de Chirurgie Orthopédique et de Traumatologie du Sport, Hôpital Sud, CHU de Grenoble, BP 217, 38043 Grenoble Cedex, France. Address requests for reprints to Dr. Tourné.

The average preoperative hallux valgus angle (between M1 and P1) was 43° (range 26° to 68°). The average preoperative intermetatarsal angle (between M1 and M2) was 15° (range, 7° to 25°).

The average preoperative metatarsal spread angle (between M1 and M5) was 33° (range, 20° to 45°).

The interphalangeal joints of the great toes were free of any degenerative lesions at the time of surgery. All MTP joints had degenerative osteoarthritis lesions radiologically and clinically at the time of surgery. Forefoot lesions were present in 33 of 42 cases (81.6%). Twenty cases had degenerative arthritis with dislocation or subluxation of the MTP joints of the lesser toes (MP2, MP3, MP4). Thirteen cases had hammertoes at the proximal interphalangeal joints of the lesser toes (IPP2-IPP3-IPP4). All patients presented with pain from the M1 medial exostosis, metatarsalgia of the lesser toes, and poor footwear tolerance.

Methods

Arthrodesis was performed by articular surface resection and was stabilized by a 4.0-mm diameter cancellous bone screw directed from the proximal phalanx toward the first metatarsal. In the second stage of the intervention, a four-hole, 1/4-inch tubular screwed plate was positioned dorsally over the bone junction and held in place using four 2.7-mm diameter screws. The procedure did not vary from the above description in 32 cases. In six cases, however, a six-hole screwed plate was used. In three cases, a pin was necessary to stabilize the setting. In one case, the compression screw was not used.

The 20 MTP dislocations or subluxations were treated using a silicone elastomer ball-shaped spacer, and the 13 hammertoes, with an interphalangeal arthroplasty, fixed with temporary pins.

Local nerve blocks were of significant use in the immediate postoperative period. A postoperative shoe allowed complete weightbearing, with the foot flat on

TABLE 1
Anatomicoradiological Results

	Preoperative average values (N = 42)	Postoperative average values (N = 41)	P values
M1P1 angle	43° (26°–68°)	17° (8°–28°)	P < 0.0001
M1P2 angle	15° (7°–25°)	11° (3°–18°)	P < 0.0001
M1P5 angle	33° (20°–45°)	28° (18°–38°)	P < 0.0001

the first operative day without any load on the forefoot. No rolling or bending of the foot was allowed for 45 days while walking, after which the arthrodesis was considered to be fused. At the end of the third month, walking with heeled shoes was permitted. The metal component was removed only in case of problems with pain.

The statistical study was made using PCSM software, developed by Delta-Soft (France), and several statistical tests were used: descriptive simple, the Wilcoxon *t*-test, the Kruskal-Wallis H-test, and the Spearman correlation ranks.

RESULTS

Postoperative Complications

An inflammatory scar with rapid onset developed in one case. One deep venous thrombophlebitis and one nonhemorrhagic gastritis occurred.

Evaluation of Data

Results focused on 41 arthrodeses. One patient was lost to follow-up, leaving 41 arthrodeses for follow-up. Results were evaluated from anatomicoradiological, functional, and global points of view.

Anatomico-radiological results (Table 1, Fig. 1, A and B). Bone consolidation occurred within an average of 60 days in all cases (46–90-day spread). Interphalangeal joint arthritis of the great toe developed in two cases (5%), causing pain along the first ray. Seventy-six percent of cases had a valgus angle between 10° and 20°, and 80% had a dorsiflexion angle between 25° and 35°.

The average postoperative hallux valgus angle value of 17° (range, 8° to 28°) decreased from 43° (26°–68°), with a statistically significant correlation ($P < 0.0001$).

Postoperative intermetatarsal angle decreased to 11° (3°–18°) from 15° (7°–25°), with a statistically significant correlation ($P < 0.0001$).

The degree of metatarsal spread declined to 28° (18°–38°) from 33° (20°–45°) with a statistically significant correlation ($P < 0.0001$).

Without first metatarsal osteotomy, metatarsus varus and metatarsal spread both decreased 4°.

Functional Results. Four patients had first ray pain

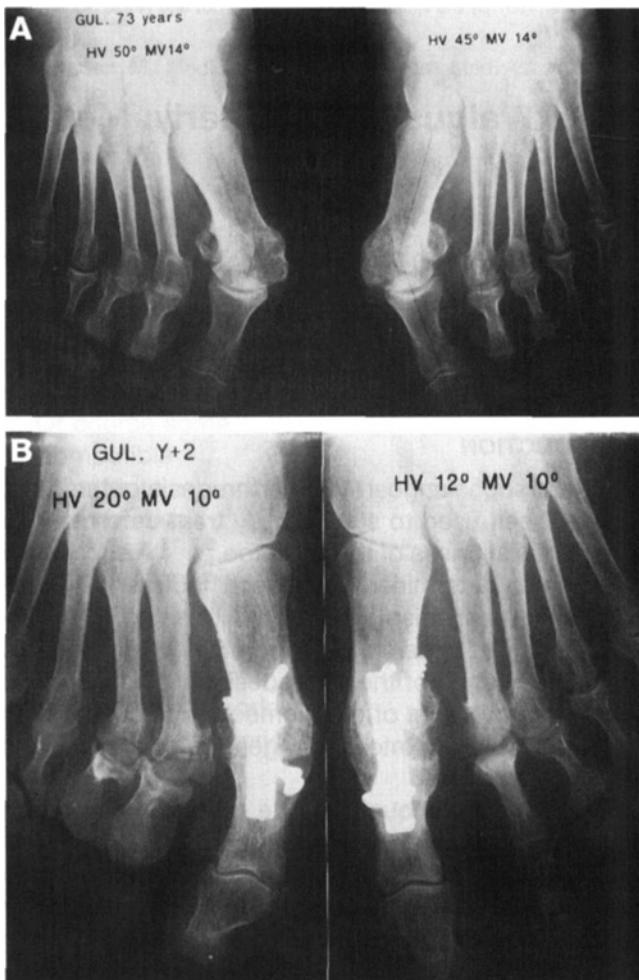


Fig. 1. A, Preoperative AP radiographs of a 73-year-old woman. B, Two years after bilateral operation, associating MTP joint arthrodeses and double-stemmed silicone implant for the second and third right lesser toes. On the AP view, good restoration of a 20° hallux valgus on the right side and a 12° valgus of the hallux on the left side.

(10%). Interphalangeal osteoarthritis was responsible in two (5%), whereas *in situ* metal component aggravation accounted for the other two (5%).

A normal gait regardless of surface was seen in 35 cases (86%), 3 cases (7%) had restrictions on uneven surfaces, and 3 cases (7%) had difficulties on flat surfaces. The patients were very satisfied in 28 cases (68%), satisfied in 11 cases (27%), and unsatisfied in 2 cases (5%).

Overall Results. A sliding scale on 100 points was devised, taking into account the effects of the arthrodesis on the first ray (50 points), the functional effects (30 points), and the patient's appraisal (20 points). A score was determined (Table 2). The results were considered excellent when the score was above 90 points, good between 75 and 89 points, fair between 50 and 74 points, and poor when less than 50 points.

TABLE 2
Sliding Scale on 100 Points

Condition of first ray: 50 points	Bony fusion obtained: 10 points $10^\circ > M1P1 > 20^\circ$: 5 points $20^\circ < \text{dorsiflexion of great toe} < 35^\circ$: 5 points IP joint normal: 15 points Painless first ray (excluding arthritis of proximal IP joint): 15 points	Pseudarthrosis: 0 point $M1P1 < 10^\circ$ or $M1P1 > 20^\circ$: 0 point $\text{Dorsiflexion} < 20^\circ$ or $> 35^\circ$: 0 point Symptomatic arthritis of proximal IP joint: 8 points Painful first ray (excluding arthritis of proximal IP joint): 0 point	Painful arthritis of proximal IP joint: 0 point
Functional effects: 30 points	Able to wear normal footwear without orthopaedic insoles: 15 points Able to walk without problems independent of terrain: 15 points	Able to wear normal footwear with orthopaedic insoles: 8 points Problems with walking on hilly terrain: 10 points	Obliged to wear orthopaedic shoes or made-to-measure footwear: 0 point Problems with walking on flat terrain: 0 point
Patient satisfaction: 20 points	Very satisfied: 20 points Satisfied: 10 points	Disappointed: 5 points	Unhappy: 0 point
Overall results	Excellent: >90 points Good: 75-89 points	Fair: 50-74 points Good: 75-89 points	Poor: >50 points

In this series, the results were excellent in 25 cases (61%), good in 13 cases (32%), poor in 2 cases (5%), and fair in 1 case (2%). 93% of the surgical results were good and excellent.

DISCUSSION

Preparation of the articular surface was accomplished by resection of the two bony surfaces,^{7,8,34} allowing the first ray to be shortened. The small cancellous bone compression screw ensures excellent contact of the two bone surfaces.^{2,3,11,13} It originates at the plantar surface of the proximal phalanx and is directed backward, upward, and toward the lateral edge of the first metatarsal.

The 1/4-inch tubular plate maintains the great toe in the desired position, while permitting an early resumption of shoe-protected weightbearing.¹⁴ Biomechanical studies confirm that there is excellent stability with the screwed plate in dorsal position as compared to other possibilities.²⁴ Many authors emphasize the use of a plate in dorsal position as the procedure that offers the lowest rate of nonunion.^{3,4,33} We had less than 10% nonunion; which compares very favorably with other reported series.^{2,3,5,7,21,22}

The recommendations for valgus angle are between 5° and 30°, with an ideal angle of 15°.^{5,8,9,25,28} We obtained a hallux valgus angle between 10° and 20°, an angle that corresponds to the physiological valgus.

The recommended angle of dorsiflexion varies between 10° and 40°.^{2,3,5,18,25,29} We positioned the MTP joint with a dorsiflexion between 25° and 35°. This seems a good compromise between the risk of overload of the first metatarsal (result of excess dorsiflexion) and that of overload of the interphalangeal joint (in cases of insufficient dorsiflexion). We had a 5% incidence of postoperative interphalangeal osteoarthritis.

Because of inconsistent results, arthroplastic resection, such as Keller or Hueter-Mayo procedures, has little place in the surgical treatment of hallux valgus. Some surgeons reserve them for major deformations in very elderly, sedentary patients.¹⁹ These surgical techniques decrease the propulsive strength of the great toe during walking, incompletely correct deformity, and produce lesser toe metatarsalgia.^{10,15,19,28}

Silicone replacement arthroplasties initially decreased pain. The initial good mobility present decreases with time. Breakdown of the prosthesis often leads to problems requiring their removal.^{1,6,16} The total nonconstraining replacement prosthesis is currently under evaluation and its efficacy has yet to be proved over time.^{17,30}

MTP arthrodesis of the great toe for severe hallux valgus in the elderly is not incapacitating. It results in a pain-free first ray in 90% of cases, normal footwear in 90% of cases, and normal gait on flat terrain in 95% of cases. Beyond age 60 years, the quality of soft

tissues and muscles is one of the main factors of recurrent deformation.^{11–13,26,27} The main advantage of arthrodesis is a painless first ray.^{4,5,20–22,29}

CONCLUSION

The first ray arthrodesis improves a stable first ray, reestablishing good condition of support on the great toe and decreasing metatarsalgia.^{11,12,15,18,25,29} Our choice of arthrodesis for elderly patients with moderate to severe hallux valgus is based on the consistently good results obtained in comparison to other methods available.

REFERENCES

- Broughton, N.S., Doran, A., and Meggitt, B.F.: Silastic ball spacer arthroplasty in the management of hallux valgus and hallux rigidus. *Foot Ankle*, **10(2)**:51–64, 1989.
- Coughlin, M.J.: Arthrodesis of the first metatarsophalangeal joint. *Orthop. Rev.*, **19**:177–186, 1990.
- Coughlin, M.J.: Arthrodesis of the first metatarsophalangeal joint with mini fragment plate fixation. *Orthopedics*, **13**:1037–1044, 1990.
- Coughlin, M.J., and Abdo, R.V.: Arthrodesis of the first metatarsophalangeal joint with vitallium plate fixation. *Foot Ankle Int.*, **15(1)**:18–28, 1994.
- Curvale, G., Croisille, H., Tracol, P., and Groulier, P.: L'arthrodèse métatarsophalangienne du gros orteil. *Rev. Chir. Orthop.*, **32**:258–261, 1987.
- Denis, A.: Le point sur les interpositions d'implants en élastomère de silicone dans la chirurgie du premier orteil. *Méd. Chir. Pied.*, **8(3)**:121–124, 1992.
- Fitzgerald, J.A.W.: A review of long term results of arthrodesis of the first metatarsophalangeal joint. *J. Bone Joint Surg.*, **51B**: 488–493, 1961.
- Fitzgerald, J.A.W., and Wilkinson, J.M.: Arthrodesis of the metatarsophalangeal joint of the great toe. *Clin. Orthop.*, **157**: 70–77, 1981.
- Girard, F., Mazas, F., Le Balc'h, T., and Margeot, M.: L'arthrodèse métatarsophalangienne du gros orteil par vissage axial en compression. *Rev. Chir. Orthop.*, **74**:221–224, 1988.
- Gregory, J.L., Childers, R., Higgins, K.R., Krych, S.M., and Harkless, L.B.: Arthrodesis of the first metatarsophalangeal joint: a review of the literature and long term retrospective analysis. *J. Foot Surg.*, **29**:369–374, 1990.
- Groulier, P.: Traitement chirurgical de l'hallux valgus et des métatarsalgies associées. Le pied—actualité en médecine chirurgie et rééducation sous la direction de Ph. Chiron et G. Utzera. Paris, Masson Édit., 1990.
- Groulier, P.: Du traitement chirurgical de l'hallux valgus et de ses complications. In *Cahiers d'Enseignement de la SOFCOT*, Conférences d'enseignement, vol. 3, 1993, pp. 13–20.
- Groulier, P., Curvale, G., Prudent, H.P., and Vedel, F.: Résultats du traitement de l'hallux valgus selon la technique de McBride modifiée avec ou sans ostéotomie phalangienne ou métatarsienne complémentaire. *Rev. Chir. Orthop.*, **74**:539–548, 1988.
- Holmes, G.B.: Technique tip: arthrodesis of the first metatarsophalangeal joint using interfragmentary screw and plate. *Foot Ankle*, **13**:333–335, 1992.
- Humbert, J.L., Bourbonniere, C., and Laurin, A.C.: Metatarsophalangeal fusion for hallux valgus: indications and effects on the first ray. *Can. Med. Assoc. Soc.*, **120**:937–941, 1979.
- Jarde, O., Trinquier, J.L., Filloux, J.F., Tran Van, F., and Vives, P.: La prothèse métatarsophalangienne Sixtine du premier rayon. Résultats préliminaires à propos de 74 cas. *Méd. Chir. Pied.*, **9(3)**:143–147, 1993.
- Koenig, R.D.: Koenig total great toe implant: preliminary report. *J. Am. Pediatr. Méd. Assoc.*, **80**:462–468, 1990.
- Lipscomb, P.R.: Arthrodesis of the first metatarsophalangeal joint for severe bunions and hallux rigidus. *Clin. Orthop.*, **142**: 48–54, 1979.
- Majkowski, R.S., and Galloway, S.: Excision arthroplasty for hallux valgus in the elderly. A comparison between the Keller and modified Mayo operations. *Foot Ankle*, **13(6)**:317–319, 1992.
- Mann, R.A., and Hagy, J.L.: The function of the toes in walking, jogging and running. *Clin. Orthop.*, **142**:24–29, 1979.
- Mann, R.A., and Katcherian, D.A.: Relationship of metatarsophalangeal joint fusion on the intermetatarsal angle. *Foot Ankle*, **10**:8–11, 1989.
- Mann, R.A., and Oates, J.C.: Arthrodesis of the first metatarsophalangeal joint. *Foot Ankle*, **1**:369–374, 1980.
- Philipes, J.E., and Hooper, G.: A simple technique for arthrodesis of the first metatarsophalangeal joint. *J. Bone Joint Surg.*, **68B**:774–775, 1986.
- Rongstad, K.M., Miller, G.J., Wanderriend, R.A., and Cowin, D.: A biomechanical comparison of four fixation methods of first metatarsophalangeal joint arthrodesis. *Foot Ankle Int.*, **15(8)**:415–419, 1994.
- Rosset, Ph., Champion, Ph., and Burdin, Ph.: Étude retrospective d'une série de 49 arthrodèses de l'articulation métatarsophalangienne du gros orteil. *Rev. Chir. Orthop.*, **74**:225–227, 1988.
- Saragaglia, D., Bellon Champel, P., Soued, I., Tourné, Y., and Butel, J.: Place de l'ostéotomie d'accourcissement de la première phalange associée à la libération des parties molles dans le traitement chirurgical de l'hallux valgus. *Rev. Chir. Orthop.*, **76**:245–252, 1990.
- Sullivan, B.T.: Use of the Reese osteotomy guide system for fusion of the first metatarsophalangeal joint. *J. Foot Surg.*, **30**:43–47, 1991.
- Sussman, R.E., Russo, C.L., Marquit, H., and Giorgini, R.: Arthrodesis of the first metatarsophalangeal joint. *J. Am. Podiatr. Med. Assoc.*, **76**:631–635, 1986.
- Tomeno, B., and Kadem, S.E.: L'arthrodèse métatarsophalangienne du gros orteil—réflexions à propos de 93 interventions. *Rev. Chir. Orthop.*, **68**:379–384, 1982.
- Tourné, Y., and Saragaglia, D.: Prothèse métatarsophalangienne à glissement Edelweiss et chirurgie du premier rayon. *Rhumatologie*, **47(4)**:137–139, 1995.
- Tourné, Y., Leroy, J.M., Maire, J.P., and Saragaglia, D.: L'arthrodèse métatarsophalangienne du premier rayon. A propos de 62 cas. *Med. Chir. Pied.*, **9(3)**:161–171, 1993.
- Turan, I., and Lindgren, U.: Compression screw arthrodesis of the first metatarsophalangeal joint of the foot. *Clin. Orthop.*, **221**:292–295, 1987.
- Von Salis-Soglio, G., and Thomas, W.: Arthrodesis of the metatarsophalangeal joint of the great toe. *Arch. Orthop. Trauma. Surg.*, **95**:7–12, 1979.
- Wilkinson, J.: Cone arthrodesis of the first metatarsophalangeal joint. *Acta Orthop. Scand.*, **49**:627–630, 1978.