Chevron Osteotomy for Hallux Valgus – SGH Experience

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Summary

Thirty-one chevron osteotomies for hallux valgus performed over a period of four years were reviewed. Their follow-up period ranged from one to five years. All the patients had pain over the bunion prior to operation. After operation, there was marked decrease of pain over the first matatarsophalangeal joint. The preoperative hallux valgus angle average 27 degrees and the postoperative angle averaged 12 degrees. The preoperative intermetatarsal angle averaged 13 degrees and the postoperative angle, 8 degrees. Ninety-one per cent of the patients were satisfied with the result of the procedure.

Key Words: Chevron osteotomy, Hallux valgus

Introduction

Hallux valgus is a deformity of the first metatarsophalangeal joint characterized by lateral deviation of the proximal phalanx and medial deviation the first metatarsal. The morbid anatomy of this condition was described by Volkman[33] in 1856. Kelikian[17] in 1965 noted that more than 130 procedures have been described for hallux valgus; ranging from fusion, resection arthroplasty to distal first metatarsal or basal first metatarsal osteotomy. Most of the operations aim to remove the medial eminence (bunion) and to correct the hallux valgus. Regardless of the operations used, the aim is a well-aligned, painless first metatarsophalangeal joint with good dorsiflexion, allowing normal progression from foot-flat to toe-off in the gait cycle. Preservation of dorsiflexion of the first metatarsophalangeal joint is important especially in women, as any decrease will adversely affect the patient's ability to wear high-heeled shoes.

The chevron procedure is a distal metatarsal osteotomy indicated for mild and some moderate hallux valgus deformities (a hallux valgus angle of less than 30 degrees and an intermetatarsal angle of less than 15 degrees) with subluxation of the metatarsophalangeal joint[2,11,24]. Overall, the chevron osteotomy has been reported to give excellent results with few complications[12]. This paper is an analysis of the results of our exprerience with the chevron procedure.

Materials and Methods

We retrospectively reviewed the results of thirty-one operations that has been done to correct hallux valgus in twenty-two patients. All the chevron procedures were performed between Jan. 1988 and Dec. 1991. All thirty-one operations were primary procedure.

The study included twenty-four feet of sixteen female patients and seven feet of six male patients. Nine patients (8 females and 1 male) underwent a bilateral procedure. The average age was thirty-four years, with a range of nineteen to sixty-five years (Fig. 1).

The indications for the chevron procedure had been pain, cosmetic reasons and problems with shoe-fitting. Pain over the medial eminence and deformity were present in all twenty-two patients with thirty-one feet

prior to surgery. None of these patients had had operation for deformity alone. Only three patients (1 female and 2 males) with five feet could wear any type of shoes before operation. The other nineteen patients had some problems with shoe fitting (particularly those with high heels) prior to surgery. None of the patient had functional disability before operation.

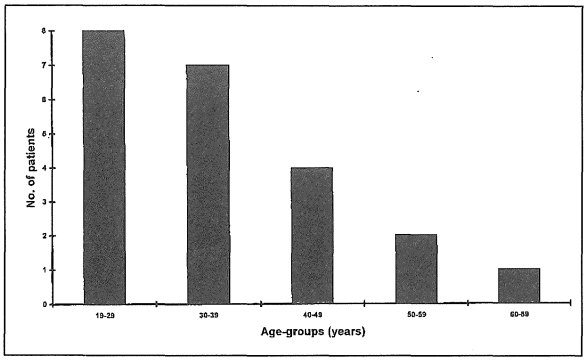

Fig. 1: Age

The follow-up periods averaged twenty-nine months, with a range of twelve to sixty months. To exclude surgeon's bias, all twenty-two patients were evaluated clinically by one of the authors who had never seen them previously and had not participated in their surgical interventions. In reviewing these patients, a strict protocol was used. The subjective evaluation included discussion of preoperative and postoperative pain in the first and lesser metatarsals, the esthetic appearance of the foot, ability to walk, satisfaction with range of motion of the big toe, preoperative and postoperative problems with shoe fitting and degree of discomfort when they walked. The objective assessment included measurement of the range of motion of the first metatarsophalangeal joint with a goniometer and clinical examination of the foot with special attention to transfer lesions and sensory abnormalities. A transfer lesion is a diffuse, clinically symptomatic callus which develops beneath the second metatarsal head because of inadequate weight-bearing on the first metatarsal, or excessive shortening or dorsiflexion of the metatarsal as a result of osteotomy of the metatarsal.

The overall results of the chevron procedure were assessed as **excellent** when there was full relief of symptoms and deformity, **good** when patient was satisfied but still had some mild symptoms and **unsatisfactory** when there was single marked flaw in the result such as metatarsalgia, significant recurrence, avascular necrosis, non-union or hallux varus.

Degenerative disease of the first metatarsophalangeal joint was classified as Grade I (mild sclerosis of adjacent surfaces of the joint), Grade II (narrowing of the cartilage space in addition to sclerosis of the surfaces of the joint), Grade III (narrowing of cartilage space, with osteophytes and cystic changes) or Grade IV (complete loss of cartilage space with increase in degree of sclerosis and cystic changes).

Preoperative and postoperative anteroposterior and lateral radiographs of the feet were made with the patient in the weight-bearing position. Measurements from the preoperative and postoperative radiographs included the hallux valgus angle (subtended by lines bisecting the long axis of the first metatarsal and proximal phalanx), the intermetatarsal angle (subtended by lines bisecting the longitudinal axis of the first and second metatarsals) and the lengths of the first and second metatarsals (the relationship of the lengths of the first and second metatarsals would indicate the amount of postoperative shortening accurately). These measurements were made with the methods recommended by the American Orthopaedic Foot and Ankle Society[30].

Operative Technique

The operation is performed through a medial incision, exposing the medial capsule of the first metatarsophalangeal joint. A inverted L-shaped plantar and distally based capsular flap is developed to expose the medial eminence[20]. The medial eminence is resected with an oscillating saw 1 mm medial to the sagittal sulcus, in line with the medial border of the foot. If the valgus deformity of the great toe is not passively correctable, a lateral capsular release is performed through the joint to allow complete correction.

A transverse medial-to-lateral 2-mm drill hole is made in the centre of the metatarsal head 5 mm from the subchondral bone to mark the apex of the chevron osteotomy. An oscillating saw blade with very fine in-line teeth to minimize shortening is used to create a

proximally-based V-shaped osteotomy in the coronal plane. The shaft of the metatarsal is then grasped with a bone clamp, and the capital fragment is translated laterally. Overdisplacement is not possible as the maximum displacement obtainable is about five millimeters[11,16]. The metatarsal head is then impacted on the proximal fragment and stabilized with a kirschner wire. The prominent metaphyseal flare created by displacement at the site of the osteotomy is then beveled with the oscillating saw. The joint is irrigated to remove fragments of bone. The medial joint capsule is plicated to overcorrect the valgus deformity slightly. The skin is approximated in a routine fashion.

Postoperatively a gauze-and-tape compression dressing is applied in the operating room and is changed weekly for six weeks. The kirschner wire is removed four weeks after the operation and passive range of motion exercises are initiated at this time. Weight-bearing is allowed on the heel and the lateral aspect of the foot. At 4 weeks, plantigrade walking is allowed.

Results

The results were categorized as subjective, objective and radiographic.

Subjective Findings

All twenty-two patients with thirty-one feet (100 per cent of the feet) complained of pain over the bunion prior to surgery. Postoperatively, the pain around the first metatarsophalangeal joint was absent in nineteen patients with twenty-seven feet. In two patients with three feet, the intensity of pain was much reduced after surgery. In one patient, the pain remained unchanged. He was dissatisfied with the result of the operation.

Preoperatively nineteen patients with twenty-six feet (83.9 per cent of the feet) had difficulty with proper shoe fitting particularly those with high heels and narrow-fitting shoe. After chevron procedure, shoe-fitting improved in fourteen patients with nineteen feet. Difficulty with high heels remained a problem in four patients with six feet. The remaining one patient still required broad-fitting shoes. None of the three patients who had no preoperative difficulty with shoe fitting, needed special footwear postoperatively.

Postoperative cosmetic appearance of the foot was considered to be satisfactory for twenty-one patients with thirty feet (96.8 per cent of the feet). The reason for esthetic dissatisfaction in the patient was recurrence of hallux valgus. Hallux varus was not a problem in this series.

Fifteen pateints (68.2 per cent), when questioned about ability to walk without discomfort, said that they could walk farther postoperatively. The remaining seven patients responded to the question by saying that their pattern of walking had not changed. None of the patient had a decrease in walking ability.

Twelve patients (54.5 per cent) responded to the question about the level of satisfaction (Fig. 2) with the results of the chevron osteotomy by saying that they were very pleased with the overall result. Eight patients (36.4 per cent) said that they were satisfied. These twenty patients stated that they would undergo the same type of operative intervention given the identical circumstances. The remaining two patients were dissatisfied because of persistent pain over the first metatarsophalangeal joint in one patient and recurrence of valgus deformity with metatarsalgia in the other.

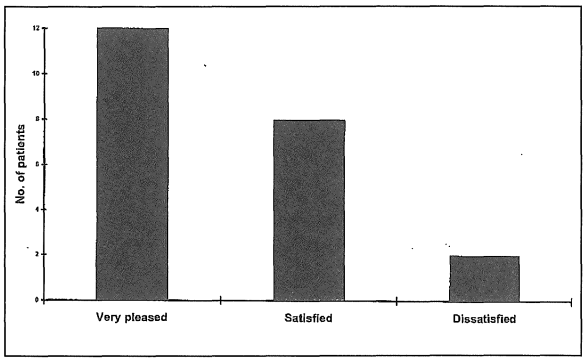

Fig. 2: Level of Satisfaction

Objective Findings

The transfer lesions which were observed preoperatively in fourteen feet disappeared in eight feet. The callus remained unchanged and continued to be painful on palpation after the operation in the other six feet. One patient who had not had a transfer lesion prior to

surgery, developed a callus with metatarsalgia when the valgus deformity recurred postoperatively.

There was sensory loss over the medial aspect of the great toe in seven feet. This numbness did not cause any problems related to footwear and none of the patients was dissatisfied.

Postoperative active dorsiflexion of the first metatarsophalangeal joint averaged thirty-nine degrees with the range of twenty to fifty-eight degrees. The dorsiflexion of the first metatarsophalangeal joint was thirty degrees or more in twenty feet. The remaining eleven feet had less than thirty degrees of dorsiflexion of the first metatarsophalangeal joint; six of these eleven feet had problems with wearing high-heeled shoes. Postoperative active plantar flexion of the first metatarsophalangeal joint averaged six degrees, with a range from 0 to 26 degrees. No symptoms were attributed to limitation of plantar flexion.

Of the thirty-one operations performed, twenty (64.5 per cent) were graded as excellent, nine (29.0 per cent) good and two (6.5 per cent) unsatisfactory (Fig. III).

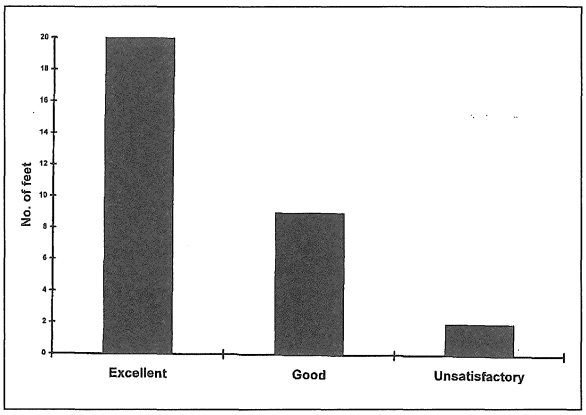

Fig. 3: Overall results

Radiographic Findings

After the chevron procedure, the hallux valgus angle was corrected an average of 14.8 degrees. The preoperative hallux valgus angle averaged 27.0 degrees ± 6.5 degrees S.D. (range 18 degrees to 40 degrees). The immediate postoperative radiographs of all the patients were reviewed and the average hallux valgus angle was 12.2 degrees ± 5.1 degrees (range 2 degrees to 22 degrees). The immediate postoperative hallux valgus angle was more than 15 degrees in four feet. Analysis of radiographs done during the survey, averaged thirty months after operation, revealed that the hallux valgus angle was increased by 2 to 10 degrees (average 5.2 degrees) in six feet. In the other twenty-five feet (80.6 per cent), the correction to hallux valgus angle was maintained.

The intermetatarsal angle was corrected an average of 4.8 degrees after chevron osteotomy. The preoperative intermetatarsal angle averaged 13.0 degrees ± 2.9 degrees SD (range 8 degrees to 19 degrees). The average immediate postoperative intermetatarsal angle was 8.2 degrees ± 1.8 degrees (range 4 degrees to 12 degrees).

Analysis of radiographs done during the survey revealed that none of the feet had evidence of avascular necrosis of the first metatarsal head.

The average amount of metatarsal shortening was 4.2 millimeters (range 2 to 6 millimeters) after chevron procedure. None of the patients complained of having a short hallux.

Osteoarthrosis of the first metatarsophalangeal joint was graded as 0 in 29 feet (93.5 per cent) and I in two feet (6.5 per cent) preoperatively. Postoperatively, osteoarthrosis of the first metatarsophalangeal joint increased by one grade in two feet and two grade in one foot. The patients who developed postoperative degenerative joint disease believed that the stiffness of the joint had increased after the surgery, although the range of motion of their first metatarsophalangeal joint was found to be satisfactory clinically. These patients did not experience more postoperative pain over the metatarsophalangeal joint and the overall satisfaction was not affected by the degree of osteoarthrosis.

The patients were divided based on preoperative hallux valgus angle into two groups, mild deformity (20 degrees and less) and moderate deformity (21 degrees to 40 degrees). The degree of improvement of the hallux valgus angle after chevron osteotomy was more in the moderate deformity group (17.2 degrees) compared to the mild group (10.5 degrees). No

difference could be detected between the two groups with regard to the subjective and objective findings.

Complications

In this series, none of the patients had avascular necrosis of the first metatarsal head clinically or radiologically. No osteotomy non-union was detected in this group of patients.

One of the feet developed superficial wound infection which subsided with antibiotics. There was no pain or stiffness of the first metatarsophalangeal joint experienced by the patient after the infection cleared up. She was satisfied with the result and had good overall result. In this series, there was no deep infection or pin-tract infection necessitating removal of kirschner wires.

The valgus deformity recurred in one foot. This recurrence was associated with a transfer lesion which was not present preoperatively. The patient was dissatisfied with the operation.

In seven feet, there was loss of sensation over the medial aspect of the great toe. This sensory loss did not affect the clinical result. None of the patients was dissatisfied because of numbness over the medial aspect of the great toe.

Discussion

Of the thirty-one chevron procedures done for hallux valgus in our unit in four years, twenty-nine (93.5 per cent) were graded as excellent or good. This overall result was comparable with other reported series such as Pochatko *et al*[27] (1994) 91%, Hirvensalo *et al*[11] (1991) 75%, Kitaoka *et al*[19] (1991) 89.5%, Meier *et al*[24] (1985) 90%, Lewis *et al*[22] (1981) 93% in which the chevron osteotomy was used.

Twenty of our twenty-two patients (90.9 per cent) were either very pleased or satisfied with the result of the chevron procedure. This satisfaction rate of 90.9 per cent in our series was similar to that reported by other authors such as Donnelly *et al*[4] (1994) 83.3%, Resch *et al*[28] (1994) 94.3%, Johnson *et al*[15] (1991) 92%, Velkes *et al*[32] (1991) 90%, Zimmer *et al*[35] (1989) 85%, Hendrix *et al*[8] (1989) 84%, Hattrup *et al*[6] (1985) 92%.

It is important to re-establish the normal relationships in the foot; otherwise, transfer metatarsalgia often develops. In this present series, the hallux valgus and intermetatarsal angles were corrected an average of 14.8 degrees and 4.8 degrees respectively. These values were similar to the average reported corrections of 12 to 15 degrees[6,8,10,11,16,21,22,26,27] for the hallux valgus deformity and 4 to 5 degrees[6,8,10,11,16,21,22,26,27] for the first-second intermetatarsal angle after chevron osteotomy.

Seven feet had a postoperative hallux valgus angle of more than fifteen degrees during the survey but the overall satisfaction of these patients did not differ from that of those patients who has an angle of less than fifteen degrees. This was because some of the patients were more concerned with pain relief than with the esthetic improvement of the foot. In other patients who had secondary digital valgus, correcting the hallux to neutral position was not desirable because it would result in an unacceptable gap between the first and second toes[12].

The most frequent complications associated with chevron osteotomy were recurrence or undercorrection of the valgus deformity as reported by Lewis & Feffer[22] (1981) 14%, Hirvensalo *et al*[11] (1991) 10%, Austin & Leventen[1] (1981) 10%. Coughlin[3] stated that hallux valgus may recur when the indications for the chevron procedure are expanded to include more severe deformities. Hirvensalo *et al*[11] and Meier & Kenzora[24] suggested that loss of correction (overcorrection or undercorrection) can be caused by slippage at the site of osteotomy. Johnson *et al*[16] and Pochatko et al[27] showed that use of internal fixation decreases the possibility of portoperative displacement of the capital fragment. In this present series, the valgus deformity recurred in only one foot (3.2 per cent); this rate compared favourably with that reported by Lewis & Feffer[22], Hirvensalo *et al*[11] and Austin & Leventen[1].

Although controversy exists about the correlation between metatarsalgia and first metatarsal shortening[25], there is uniform agreement that excessive shortening shifts weightbearing laterally[13,23,31]. Shortening may be

due to excessive bone resorption[1,11,18,23,24] at the osteotomy site. The mean amount of first metatarsal shortening in this study was 4.2 mm. This figure was comparable with that reported by other authors such as Kinnard & Gordon[18] (1984) 3 mm and Klosok *et al*[20] (1993) 6 mm. None of the patients in this study had more than 10 mm of metatarsal shortening, which according to Merkel *et al*[25], was associated with a higher degrees of patient's dissatisfaction and an increased frequency of metatarsalgia.

In this review, the symptomatic callus which had been present beneath the head of the second metatarsal of fourteen feet disappeared from eight (57.1 per cent) after the chevron osteotomy. After correction of the hallux valgus deformity, seven feet (six unimproved and one newly acquired) had planter callosities; this rate (22.6 per cent) compared favourably with that reported by Kinnard & Gordon[18] (53.3 per cent).

Stiffness of the first metatarsophalangeal joint was the main cause of inability to wear high-heeled shoes in our four patients with six feet postoperatively. Horne *et al*[12] stated that limitation of dorsiflexion of the first metatarsophalangeal joint negatively affects the patients' ability to wear high-heeled shoes. According to Henry & Waugh[9] and Grace *et al*[5], stiffness of the first metatarsophalangeal joint prevents weight-bearing on the hallux and lead to transfer of load to the lateral metatrarsal head. High incidence of such stiffness had previously been reported for the chevron osteotomy[12]. In our series, eleven feet (35.5 per cent) had less than thirty degrees of dorsiflexion of the first metatarsophalangeal joint; similar to the 34.2 per cent reported by Horne *et al*[12]. Helal *et al*[7] pointed out that soft-tissue dissection around the joint causes stiffness in proportion to its extent.

The most serious complication following chevron procedure is avascular necrosis[3] of the first metatarsal head. The blood supply to the first metatarsal head derives from a nutrient artery in the metatarsal diaphysis and from a second group of vessels entering the metatarsal around the capsule of the first metatarsophalangeal joint[12,14]. Mann[23] as well as Wilkinson *et al*[34] described two types of avascular necrosis, partial and whole-head avascular necrosis after osteotomy of the distal end of the metatarsal. Meier & Kenzora[24] reported that avascular necrosis developed in 20 per cent of sixty feet after chevron osteotomy and this rate increased to 40 per cent when the osteotomy had been combined with an adductor tenotomy. Hattrup & Johnson[6], Shereff *et al*[29] & Coughlin[3] also cautioned that lateral release increases the risk of avascular necrosis. In contrast, there was no case of avascular necrosis clinically and radiologically in our series; similar to that reported by Johnson *et al*[16], Austin & Leventen[1], Klosok *et al*[20] and Pochatko *et al*[27].

Conclusion

Chevron osteotomy is a technically straightforward procedure. As shown in this review, the results are very satisfactory. To obtain such good results, careful attention to detail and careful postoperative management are important.

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