Durability of venous valve reconstruction techniques for "primary" and postthrombotic reflux

Seshadri Raju, MD, Ruth K. Fredericks, MD, Peter N. Neglèn, MD, and **J. David Bass, PhD,** *Jackson, Miss.*

Purpose: **The durability of the variety of valve reconstruction techniques in "primary" reflux and postthrombotic reflux was studied.**
Methods: **A total of 423 valve repairs in 235 patients with a follow-up period ranging from 1 to 12 years were analyzed. End points for assessment consisted of ulcer recurrence and Doppler competence in serial duplex examination. Multivariate analysis with Cox proportional hazards model was used.**
Results: **Ulcer-free survival curves were similar for "primary" and postthrombotic reflux. No significant difference in ulcer recurrence was seen regardless of the technique used. Different results were obtained when valve competence instead of ulcer recurrence was used for assessment of durability. Reconstructions in "primary" reflux were more durable than those in postthrombotic reflux. Durability differences were also noted among different techniques. A cohort of posterior tibial repairs proved extraordinarily durable (0 failures in 23 repairs).**
Conclusion: **Valve reconstruction in postthrombotic reflux can yield clinical results similar to those in "primary" reflux. Although any of the several described techniques can produce similar clinical results, Doppler competence suggests the following order for choice of procedures: (1) internal valvuloplasty, (2) prosthetic sleeve in situ, (3) external valvuloplasty, and (4) axillary vein transfer. (J VASC SURG 1996;23:357-67.)**

The internal valvuloplasty technique has been shown to provide excellent results in "primary" reflux, with healing of stasis ulceration sustained over a 15-year follow-up period.[1,2] The durability and effectiveness of other valve reconstruction techniques are less well established. It is not known whether valve reconstruction techniques in general yield long-term results adequate to justify their use in postthrombotic syndrome. Herein we report long-term results with several valve reconstruction techniques in both "primary" and postthrombotic reflux.

From the Department of Surgery, University of Mississippi Medical Center.
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Reprint requests: Seshadri Raju, MD, Department of Surgery, University of Mississippi Medical Center, 2500 N. State St., Jackson, MS 39216-4505.

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MATERIAL AND METHODS

A total of 423 valve repairs were carried out in 258 limbs among 235 patients. Sixteen staged bilateral repairs were done, and in seven limbs a second valve repair was carried out after the first one failed. A total of 101 men and 134 women with a mean age of 49 ± 13 years were studied. Follow-up period ranged from 1 to 12 years (Table I). In 128 limbs a single valve was reconstructed; in 130 others multiple valves were repaired. Forty-five patients underwent simultaneous proximal saphenous vein stripping and perforator interruption at the time of valve reconstruction. Venous reflux was "primary" in 62% and postthrombotic in 38% of patients. This pathologic classification was based on gross appearance of the repaired valve station at the time of operation. Fifty-five percent of patients with "primary" reflux and 78% with postthrombotic syndrome had evidence of previous distal thrombosis on venography. Operated patients had grade 2 or higher reflux (Kistner grading method[3]) by descending venography (mean 2.4), multisystem disease (mean

Table I. Follow-up data for "primary" and postthrombotic cases; limbs/valve sites available for analysis at various follow-up intervals

	Years of follow-up					
Analysis	*0*	*2*	*4*	*6*	*8*	*10*
Ulcer recurrence						
"Primary" reflux-limbs	126	44	19	15	11	3
"Postthrombotic" reflux-limbs	85	17	10	9	3	–
Duplex competence						
"Primary" valves	194	54	23	17	12	6
"Postthrombotic" valves	112	28	10	9	3	–

Table II. Case material distribution of valve reconstrution techniques and repaired valve sites

	Site of valve							
Technique	*CFV*	*PSFV*	*Profunda vein*	*DSFV*	*Popliteal vein*	*PT*	*Peroneal vein*	*Total*
Internal valvuloplasty	1	77	2	–	–	1	–	81
External valvuloplasty	3	83	29	1	10	12	1	139
Prosthetic sleeve	–	26	55	–	1	13	1	96
Axillary vein transfer	2	25	21	3	2	1	–	54†
Angioscopic repair	1	22	6	–	–	–	–	29
Others	1	7	6	2	6	1	1	24
Total	8	240	119	6	19	28	3	423

CFV, Common femoral vein; *PSFV*, proximal superficial femoral vein; *DSFV*, distal superficial femoral vein; *PT*, posterior tibial vein. The larger tibial vein was repaired and the smaller one ligated.
Total of 128 single valve reconstructions and 130 multiple reconstructions.
†Includes three that underwent "bench repair" by external technique before transfer.

2.5) by the grading system previously described, or both.[4] The latter grading system, based on the number of major venous segments involved in reflux, shows a better correlation with hemodynamic parameters than the former method.[5]

SURGICAL TECHNIQUE

Internal valvuloplasty.[2] The valve leaflets were exposed through a transverse venotomy. Redundant valve cusps were tightened by plicating the edge of the leaflets with 7-0 Prolene sutures at each commissural end.

External valvuloplasty.[6] The valve attachment lines were defined by adventitial dissection around the valve station without a venotomy. The commissural valve angle was invariably wide.[7] The angle was closed, and valve attachment lines were brought together with a running suture of 6-0 Prolene.

Prosthetic sleeve in situ.[8] This technique was used only when the normally encountered venospasm induced by surgical manipulation restored competency to a previously incompetent valve. A prosthetic sleeve of Dacron or polytetrafluoroethylene was fitted around the slightly constricted valve station to maintain competency.

Axillary vein transfer. A competent axillary vein valve was transferred to a chosen site in the lower limb and secured with interrupted sutures.[2] A prosthetic sleeve was fitted around the transferred valve to prevent late dilatation from compliance mismatch.[9]

Angioscopic repair.[10] Transcommissural through-and-through sutures were placed across the valve attachment lines traversing the base of the leaflets. Angioscopy was used to confirm correct placement of sutures and to assess competency of the repair by irrigation.

Miscellaneous techniques. A variety of venoplastic and segment transfer procedures were used. Intraoperative competence of the repaired valve was assessed by the traditional strip test and by reverse stripping of the supravalvular venous segment against the closed valve in an effort to generate the 30 to 50 mm Hg pressure normally present in the femoral vein in the erect limb. With these maneuvers 81% of the repaired valves were found to be totally competent, and 19% were slightly leaky. Leaky repairs were included in the analysis. Intraoperative assessment in this manner correlated well with early postoperative duplex assessment in the erect position, which showed 73% of repairs to be competent, 17% to

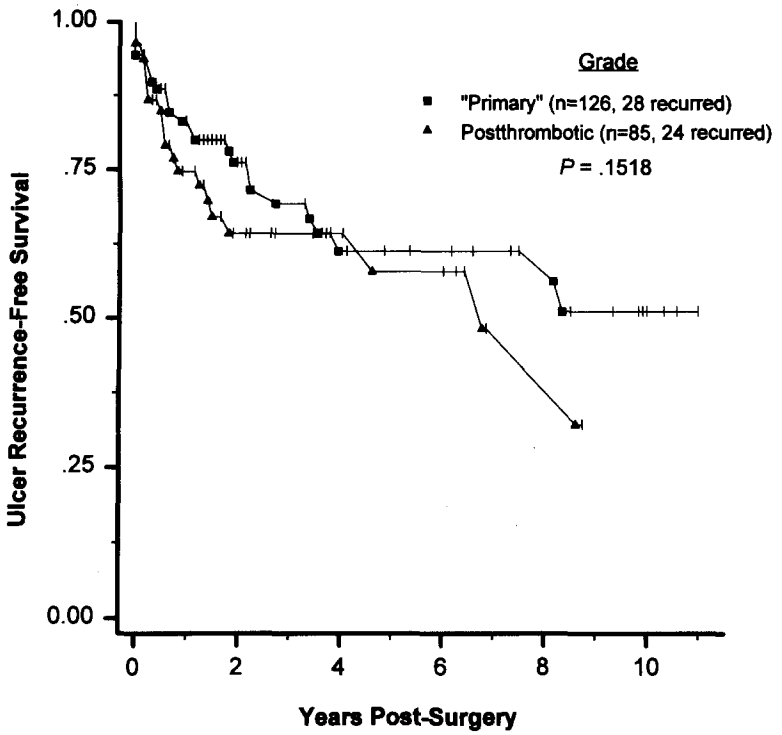

Fig. 1. Estimation of ulcer-free survival in "primary" and postthrombotic reflux. See Table I for interval follow-up data.

be slightly refluxive, and 10% to be grossly incompetent.

Primary end points for follow-up analysis were (1) ulcer recurrence and (2) Doppler competence on serial duplex examination. Valve competency was assessed in both the recumbent and erect position with rapid deflation cuffs in the erect position. Valve competency was qualitatively graded as competent, slightly refluxive, or grossly incompetent.

Statistical analysis. Categoric data were expressed in count frequencies (percent). In calculating the two primary end points (ulcer recurrence and Doppler competence) the duration interval was computed from the date of operation until either occurrence of treatment failure (event) or date of last follow-up among successful cases (censored). Kaplan-Meier estimates of survival were computed to provide illustration, and differences between strata were tested with the log rank statistic. Stepwise implementation of the proportional hazards regression model (Cox) provided the ability to select significant prognostic factors found among multiple concomitant variables. Significance was set at the 0.05 level, and all tests were two-sided. The SAS statistical package for personal computers (SAS Institute, Inc., Cary, N. C.) was used to perform all analyses.

RESULTS

A total of 423 valve repairs in 258 limbs were analyzed (Table II).

Ulcer recurrence. Of the 258 limbs, 211 (82%) were operated for stasis ulceration. Of these, 10 never had healing of their ulcers after operation, and 43 others had subsequent recurrences after initial healing during the observation period. The remaining 158 limbs were free of ulcers and were censored in constructing Kaplan-Meier plots. Data regarding postoperative stocking use as reported by patients was available in 103 limbs (20 recurrent ulcers and 83 healed ulcers). Thirty-five percent with recurrences did not use stockings, 25% used them intermittently, and 40% used them on a daily basis. Among patients with healed ulcers 27% did not use stockings at all, 34% used them intermittently, and 39% used them on a constant basis. No significant statistical difference was seen between the two clinical groups in stocking use. No significant difference was seen between "primary" reflux and postthrombotic reflux in terms of ulcer recurrence (Fig. 1). Ulcer-free survival curves were similar, with no significant difference between the various surgical techniques used (Fig. 2). No difference in ulcer-free survival was seen between single and multiple repairs. The addi-

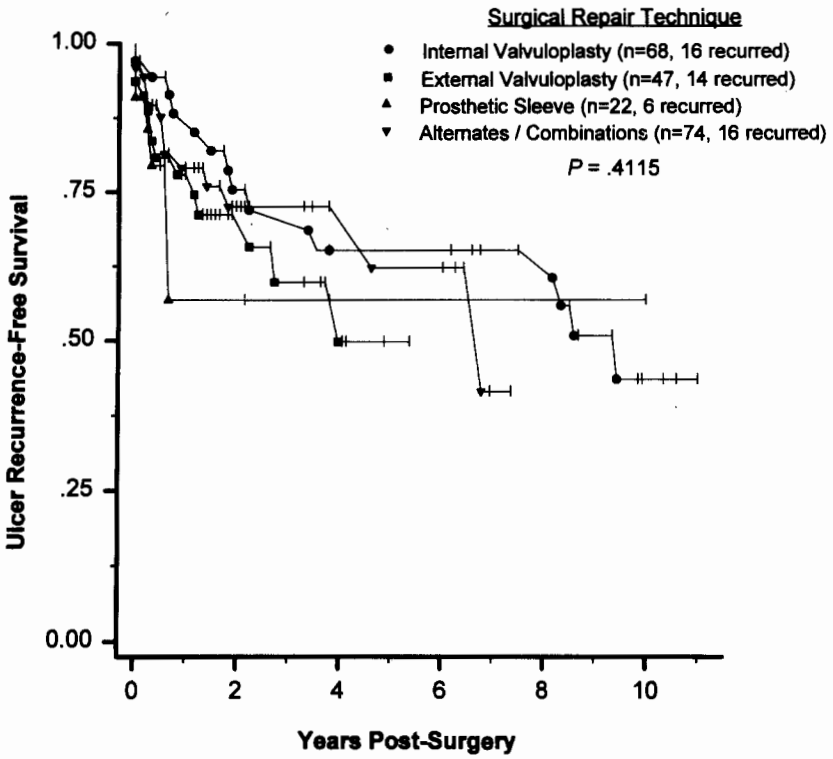

Fig. 2. Estimation of ulcer-free survival based on surgical technique used in valve reconstruction. No difference was seen between different reconstruction techniques; ulcer-recurrence-free survival curves were similar. Fifty-four axillary vein transfers are included in group alternates/combinations; as separate group, 54 axillary vein transfers had ulcer recurrence similar to other techniques.

tion of saphenous stripping and perforator interruption to valve reconstruction yielded somewhat inferior results (60% vs 72% at 2 years, $p < 0.03$), but the follow-up of the latter procedure has been relatively short (2 years). The site of valve repair showed a significant advantage for the proximal superficial femoral vein compared with all other locations (Fig. 3). Multivariate analysis by the Cox method confirmed this difference ($p < 0.0002$).

Eighteen percent of patients operated for nonulcerative symptoms of severe chronic venous insufficiency (pain, painful swelling, etc.) reported relief of symptoms roughly similar to that observed in patients with ulcers. Probability of symptoms relief (Kaplan-Meier) was 55% at 5 years in this group. We did not include this group in our detailed analysis, because the symptoms (unlike ulcer) were subjective. Objective signs were lacking, and time-related end points were diffuse because of fluctuations and gradations in symptom evolution when they recurred. These features made it difficult to relate clinical outcome to duplex results in this category of patients.

Valve competency by duplex Doppler. Serial duplex analysis was performed to evaluate the durability of valvular incompetence. Among the 423 valves repaired, follow-up assessment was available on 306 valve sites in 207 patients (Table III). Univariate analysis with the Kaplan-Meier technique disclosed significantly prolonged competence of the reconstructed valve among patients with "primary" reflux in comparison with those with postthrombotic syndrome (Fig. 4). Cox analysis showed this difference to be significant ($p < 0.04$). Early steep drop in the curves largely represents intraoperative failures (see Material and Methods). Significant differences were also seen among the various surgical techniques in terms of durability of competence. The internal valvuloplasty and prosthetic sleeve in situ were more durable than external valvuloplasty by Cox analysis ($p < 0.002$) and were also more durable than axillary vein transfer ($p < 0.0001$). In order of durability the technical procedures can be ranked in descending order as follows: (1) internal valvuloplasty, (2) prosthetic sleeve in situ, (3) external valvuloplasty, and (4) axillary vein transfer (Fig. 5). Only seven

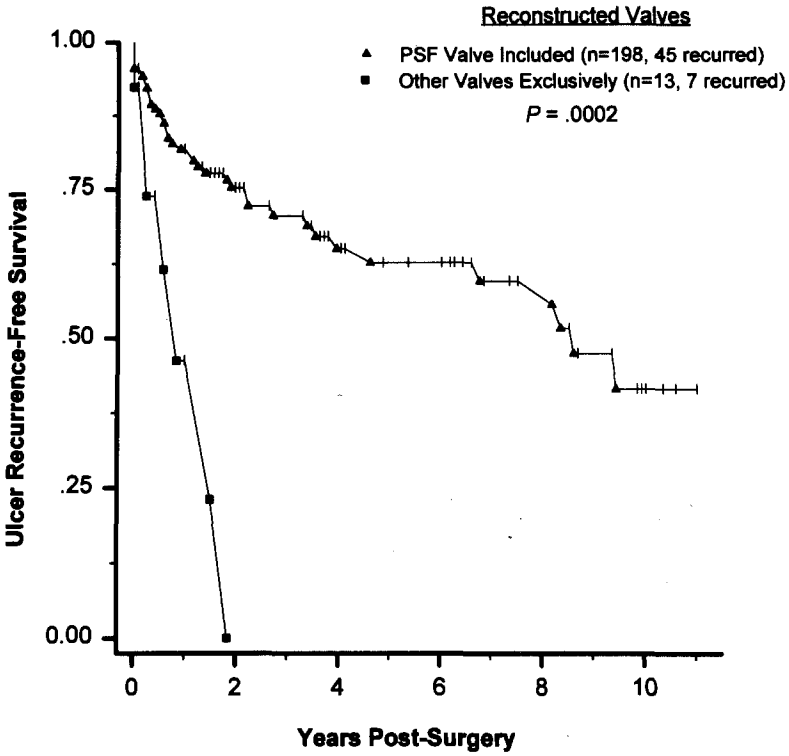

Fig. 3. Effect of valve reconstruction site on ulcer-free survival. Proximal valve station in superficial femoral vein was superior to that of all other locations.

Table III. Serial duplex follow-up of repaired valve stations

	Site of valve						
Technique	*CFV*	*PSFV*	*Profunda vein*	*DSFV*	*Popliteal vein*	*PT*	*Total*
Internal valvuloplasty	1	69	–	–	–	1	71
External valvuloplasty	3	72	18	1	9	8	111
Prosthetic sleeve	–	21	37	–	1	13	72
Axillary vein transfer	2	22	16	2	1	1	44
Angioscopic repair	1	7	–	–	–	–	8
Total	7	191	71	3	11	23	306

A total of 306 reconstruction sites among 207 limbs were assessed.
CFV, Common femoral vein; *PSFV*, proximal superficial femoral vein; *DSFV*, distal superficial femoral vein; *PT*, posterior tibial vein.

valve sites were available for analysis after angioscopic valvuloplasty, too small a sample to reach definitive conclusions. When Fig. 2 is compared with Fig. 5, it can be seen that ulcer recurrence does not automatically follow when the reconstructed valve fails by duplex Doppler examination, that is, the incidence of ulcer recurrence appears to lag behind the incidence for recurrence of reflux at the repaired valve site for a given follow-up interval (Fig. 6). However, few ulcers recurred when the repaired valve remained competent. Only four such recurrences were noted in this category. A subset of posterior tibial valve repairs was extraordinarily durable in terms of Doppler competency. Thrombosis of the repaired segment was not a factor, because patency was confirmed by duplex examination (0 failures in 23 repairs [Fig. 7]). The posterior tibial valve site was in fact more durable in this regard than the proximal superficial femoral vein site (Cox analysis, $p < 0.05$). The posterior tibial site was also superior to other nonsuperficial femoral vein sites ($p < 0.02$).

DISCUSSION

It is clear from these results that patients with deep venous insufficiency, whether caused by "primary" reflux or postthrombotic syndrome, can ben-

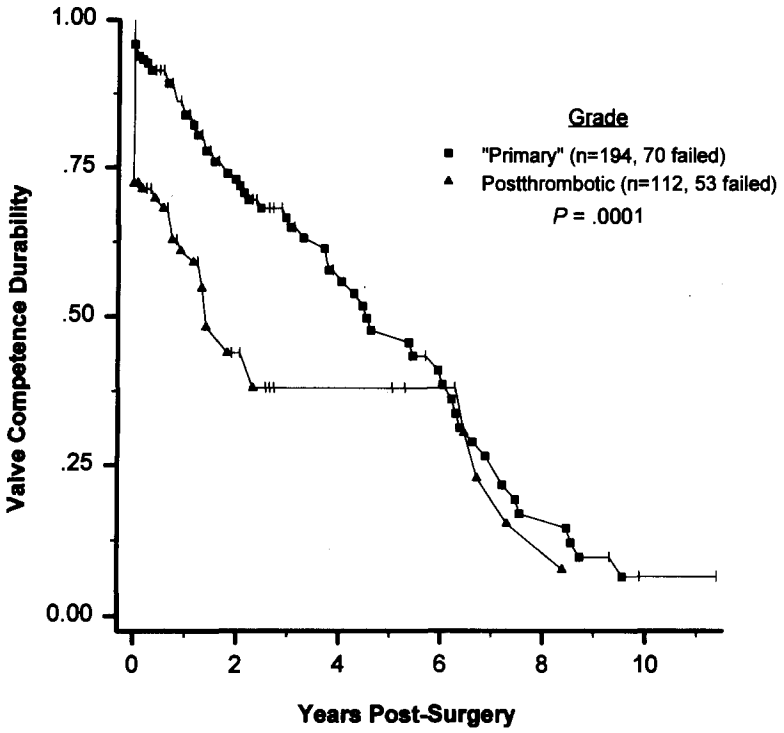

Fig. 4. Actuarial durability curves for all assessed valve repairs. Repaired valves remained competent by serial duplex examination significantly longer in "primary" reflux compared with postthrombotic reflux. Much of difference appears to be due to more frequent "early" failures of reconstructed valve in postthrombotic syndrome. See Table I for interval follow-up data.

efit from a valve reconstruction procedure. It is surprising that ulcer healing rates comparable to "primary" reflux were observed in postthrombotic syndrome. The sustained ulcer healing reported spans a follow-up period of 12 years and represents a better outcome for these groups of patients than any other therapeutic method reported in the literature. Similar results were observed for single valve repairs and multiple reconstructions; results were actually somewhat inferior when saphenous stripping and perforator interruption were added. Because these procedures represent different reflux diseases (primary, postthrombotic, and multisystem disease, respectively), this analysis should not be interpreted to suggest that multiple valve repairs or elimination of saphenous and perforator reflux do not have therapeutic benefit. The guiding principle in treatment should be to eliminate all significant axial and collateral reflux and prevent circus reflux flow. On the basis of this principle, choice of procedure will be dictated by existing disease and distribution of reflux. Lack of a precise pathophysiologic classification based on accurate quantification and regional distribution of reflux has impeded the setup of controlled trials in which different therapeutic modalities, both conservative and surgical, could be compared for their effectiveness. Although the pioneering work of Kistner has already established the utility and durability of internal valvuloplasty, the data presented here support the usefulness of other techniques. Ulcer healing rates similar to those with internal valvuloplasty can be obtained with prosthetic sleeve in situ, external valvuloplasty, or axillary vein transfer as used in this study. In this regard it should be noted that prosthetic sleeve in situ was selectively used in only those patients in whom venospasm induced by surgical manipulation resulted in rendering a previously refluxive valve competent. We have reservations about using this technique for valve stations that remain grossly refluxive even after surgically induced venospasm has set in.

Internal valvuloplasty is a precise but time-consuming technique. It may not be applicable in some patients, for example, elderly fragile patients, because of the time factor. Technical considerations such as obesity, limited exposure, or a small-caliber vein may also preclude its use. For the last reason it is difficult to perform in the profunda femoral,

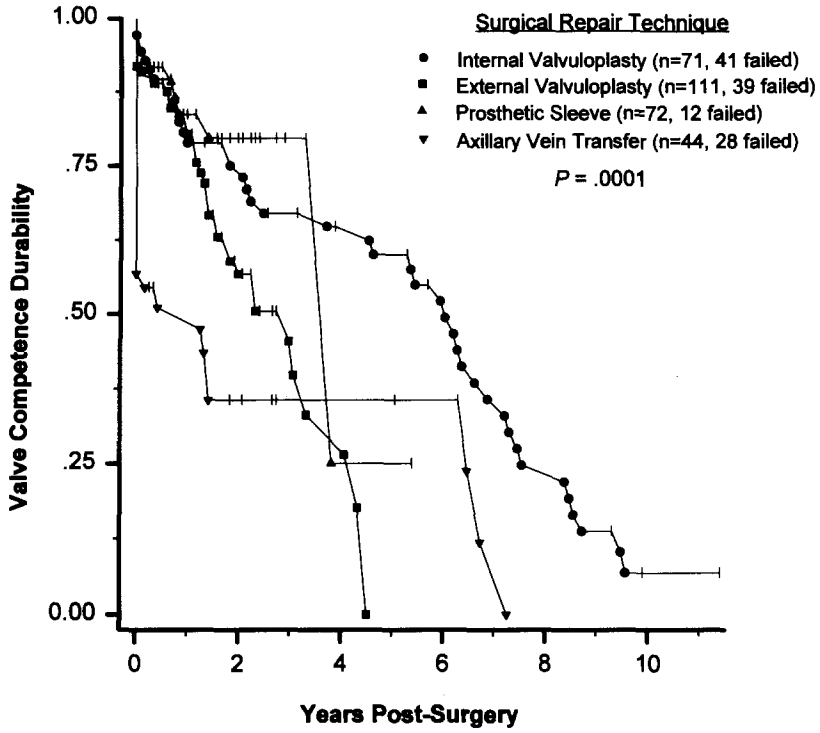

Fig. 5. Actuarial durability of various valve reconstruction techniques assessed by serial duplex examination for competence.

posterior tibial, or other small-caliber veins. Other reconstruction techniques, notably the prosthetic sleeve in situ and external valvuloplasty, do not have these limitations, are rapidly executed, and do not involve a venotomy. Although ulcer healing after these alternative reconstruction techniques is similar to that after internal valvuloplasty, significant differences are seen among the various techniques with regard to durability of Doppler competency. Internal valvuloplasty and the prosthetic sleeve in situ are the most durable, whereas external valvuloplasty and axillary vein transfer are less durable in that order. It is our recommendation that the prosthetic sleeve in situ be used whenever the selection criteria noted previously are satisfied. It is a simple, rapid, and durable technique that does not require venotomy and provides ulcer healing rates as good as those of any other technique. The durability of this technique may be related to the fact that the underlying valve is only minimally refluxive, because competence is easily restored by mild venospasm induced by surgical manipulation. The internal valvuloplasty should be the next choice for use when reflux persists after venospasm. When technical and other considerations do not permit the use of internal valvuloplasty, external valvuloplasty may be considered. However, because of its inferior durability the external technique should not be substituted for the internal technique simply because of technical ease; the internal technique should be used whenever feasible, even though it is technically more demanding. Angioscopic valvuloplasty appears to combine the best features of internal and external valvuloplasty techniques, does not require a long venotomy, and is reasonably fast. Our follow-up experience with this technique, however, is limited, and we are unable to make a definitive recommendation for its use on the basis of follow-up data. The axillary vein transfer technique requires axillary vein exposure, takes considerable time to perform, and requires exacting technique for achieving a competent reconstruction. The exposed axillary valve may be incompetent,[2] requiring "bench repair" before transfer,[11] or a search for another valve that is competent may be necessary. Axillary vein transfer should be used only when other techniques cannot be used. When the valve structure is completely destroyed by postthrombotic syndrome, it may be the only technique that can be used. Previous suggestions[2] that axillary vein transfer may yield ulcer-healing rates lower than internal valvulo-

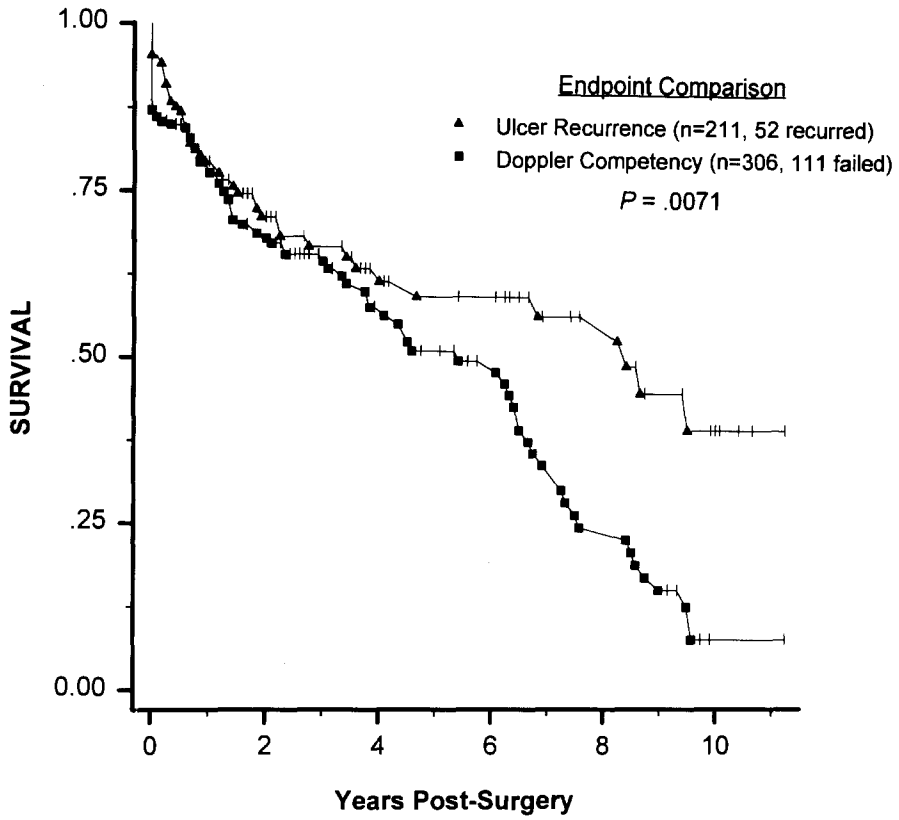

Fig. 6. Lag apparently exists between incidence of repaired valve failure and recurrence of stasis ulcer (actuarial data).

plasty were not substantiated by long-term follow-up data. Ulcer healing rates for all techniques including axillary vein transfer were similar (Fig. 2).

Serial duplex examination is the preferred technique for serial follow-up examination of reconstructed valves because it is noninvasive. The introduction of automated cuffs with a quick deflation feature[12] has standardized the examination technique. In competent hands valve assessment accuracy is superior to that of descending venography.[4,13] Descending venography is not an appropriate technique for routine follow-up because of its invasive nature and high cost. Its sensitivity in assessing distal valves is poor,[4] unless a separate popliteal puncture is performed. It does, however, provide greater anatomic detail than duplex examination. We reserve its use for preoperative assessment and for investigation of patients with recurrences who may need further therapeutic intervention.

Early steep drop in competence noted in Fig. 4 is largely due to intraoperative failures (19%). This finding suggests that results could be further improved, if a totally competent repair can be achieved at operation. A dichotomy appears to exist between ulcer recurrence and recurrence of reflux of the reconstructed valve site. This finding is reminiscent of arterial bypass procedures in which limb salvage rate is consistently higher than reported graft patency. We can offer several speculative explanations for this dichotomy. (1) Because the onset of stasis ulceration is an indolent, slowly evolving process, a time lag may be present between the appearance of recurrent reflux and the onset of ulceration. Further follow-up extending to 20 years or more may be necessary to prove this point. (2) Durability of Doppler competence was assessed for each reconstructed valve site. After multiple valve reconstructions, even when one repaired valve becomes incompetent, others may maintain their competency, resulting in an ulcer-free state. (3) Assessment of the repaired valve was qualitative, because it was graded as competent, leaky, or incompetent. A reconstructed valve that has deteriorated and started leaking may still offer some resistance to reflux flow, explaining a continued ulcer-free

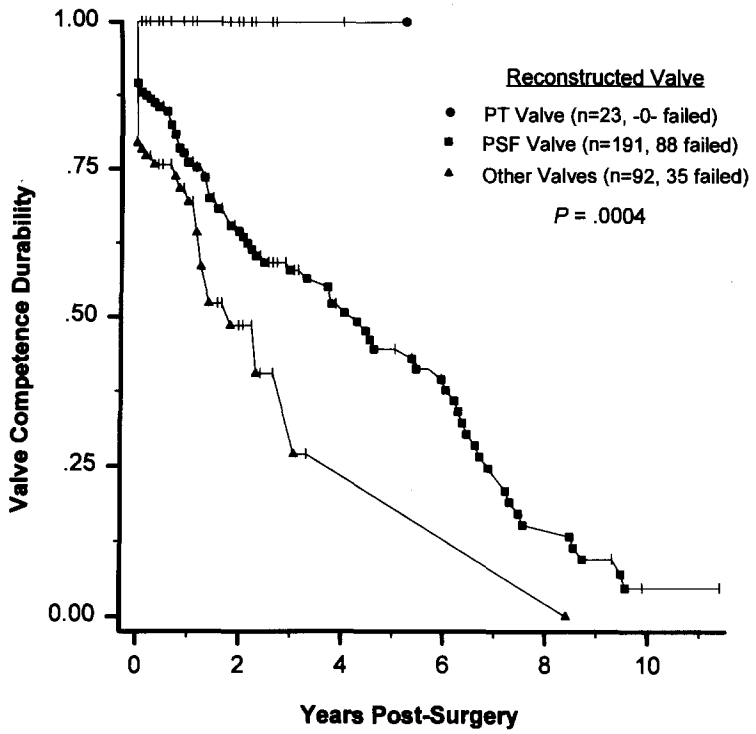

Fig. 7. Group of posterior tibial reconstructions were extraordinarily durable (0 failures in 23 repairs) compared with other anatomic repair sites in Doppler competence.

state. More quantitative techniques that assess reflux such as valve closure times and air plethysmography have been in use since they became available. However, the follow-up interval is not adequate to draw appropriate conclusions from this data. In spite of the noted time lag, ulcer recurrence was clearly related to the recurrence of reflux. Ulcer recurrence was rare (4 of 53 recurrences) when the repaired valve remained competent.

The proximal superficial femoral vein valve site was superior to all other reconstruction sites in terms of ulcer recurrence. Some authors have argued that valve reconstruction should be undertaken in the distal superficial femoral or popliteal veins rather than the proximal superficial femoral vein because of the "gate-keeper" function of the former two sites resulting from their proximity to the calf venous pump. Our findings do not support this hypothesis.

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DISCUSSION

Dr. Thomas F. O'Donnell (Boston, Mass.). Thank you, Drs. Rutherford, Whittemore, and Johnston.

Dr. Raju and his associates this afternoon have reported the largest series on deep venous reconstruction available in the literature other than a recent report of over 1200 valve repairs by Zhang et al. from China. Unfortunately, that latter report provided very few details, in contrast to the article presented to you this afternoon.

The most interesting aspects of this report are the following. First, 423 valve repairs were carried out without any evidence of thrombosis. This unequivocally puts to rest the concern about thrombosing a venous segment with reconstructive venous surgery if done in a competent manner.

The second major point of interest is the diametrically opposite conclusions reached by the present authors from that of Bob Kistner and associates presented by this Society several years ago. In their results on 51 limbs followed for a mean of 10.6 years 3 years ago to this Society, Kistner showed "dramatic differences between valvuloplasty, surgical procedures for primary valvular incompetence and vein substitutions for the postthrombotic syndrome, 73% symptom relief for primary valvular disease and 43% for postthrombotic disease." Kistner concluded that the limbs after surgery for postthrombotic syndrome (PTS) had a worse course because PTS was either a different disease process that may be more virulent or, alternatively, substitute venous reconstruction procedures were not as good as direct valvuloplasty. Dr. Raju's presentation clearly challenges that concept. The authors showed no difference in the long-term clinical results between surgery for postthrombotic reflux and that for primary valvular reflux.

Like Kistner's paper, however, today's article did see an advantage for internal valvuloplasty over indirect techniques such as axillary vein transfer for valvular competence.

As the authors have shown in this method, we favor the ulcer-free interval method of expressing results, similar to that used for limb salvage. Indeed, these venous reconstructive procedures for ulceration might be termed "skin salvage procedures." We reported our data recently[1] and showed an exactly comparable 62% cumulative ulcer-free interval rate very similar to those of the authors.

I have several questions for the authors.

The incidence of primary valvular incompetence in this series seems higher than most series. Could the authors explain this?

Would the authors rationalize what appear to be biases in this study? Were certain techniques done during the earlier phases of the study and perhaps discarded? There were five techniques mentioned plus a final catch basket. What technique do the authors currently use? Is it angioscopic internal valvuloplasty? While the authors also state there is no advantage to a distal venous reconstructive site, there was such a small number that any conclusion may be clouded by a type II error.

And finally, did the authors agree that the time is ripe for a randomized prospective trial comparing surgery with elastic compression stockings to prove that the scalpel may be better than the elastic compression stocking?

I enjoyed this article and commend it to you when it is available in the journal, it contains a wealth of information.

Dr. Seshadri Raju (Jackson, Miss.). Thank you, Dr. O'Donnell for those comments.

The difference between our series and Dr. Kistner's experience is that we primarily employed multiple valve reconstructions in postthrombotic cases, whereas Dr. Kistner exclusively used single reconstructions. Also, of the 14 cases reported by him one particular technique, namely the segment transfer technique, was employed in 12. This technique has had a high failure rate in ours' and others' experience. These are possible explanations for the outcome differences noted between the two series. The incidence of "primary" reflux is apparently high in this series because of the method of classification. Since we were analyzing durability of Doppler competence of the repaired valve, it made sense to base the classification on the monitored valve station rather than the entire limb. So if the repaired valve had no postthrombotic wall changes, it was classified as "primary" even though there might have been distal postthrombotic changes. The incidence of "primary" reflux will be lower if the classification was based on the entire limb.

Even though we have relied heavily in the past on the four techniques reported herein, we are increasingly leaning towards the technique popularized by Dr. O'Donnell, namely angioscopic repair. This technique appears to combine the best features of internal valvuloplasty and external valvuloplasty. It is fast, allows visual observation of valve cusp pathology, and dynamic valve function after repair can be assessed with angioscopic irrigation. It is our preferred technique today. However, we do not have enough long-term follow-up data as yet to have included the results in our presentation.

Your comment about type II error with regard to outcome differences noted for valve repairs at certain sites is well taken. Although the numbers are small, the differences were dramatic enough to be reported. This bears further study.

Surgery versus elastic stocking. This is a long-standing controversy. Our approach to severe venous stasis is to try conservative measures first. If they fail or if complications develop during conservative therapy, then valve reconstruction is considered. Such an approach appears to work well for most conditions where there is a surgical option and a medical option for treatment.

It is somewhat ironic that at this point long-term follow-up data extending up to 15 years or more after valve reconstruction are available in the literature, while the same cannot be said for stocking or other forms of compression therapy that have been in use for a much longer time than valve reconstructive surgery. Our clinical impression is that conservative therapy in severe venous stasis is prone to higher recurrence and complications requiring more frequent hospital visits and admissions than after valve reconstruction surgery. Relative costs is another factor worth looking into. To mount a randomized trial comparing conservative therapy versus surgery, standardization of pathology, hemodynamic parameters, and clinical severity is necessary. The new CEAP classification may provide us with the foundation to mount such trials in the future.

Dr. Anthony M. Imparato (New York, N.Y.). Did you have the opportunity to examine any of the operative sites in the failed cases to try to work out the mechanism of failure? Was it in the valve, was it the vein wall, was it at suture lines? What precisely was the mechanism?

Dr. Raju. Dr. Imparato, 4% of the cases reported in this series were "redo" operations; only a fraction of failed repairs require reoperation, as many remain ulcer-free even after the failure of the repair, as we have indicated. When a repeat valve reconstruction is undertaken, we prefer a fresh incision rather than exploring the old repair site encased in scar tissue. For this reason direct examinations of the failed valve repair site has been few and far between. However, all cases where the repair had failed were intensively studied by duplex and contrast studies, especially when ulcer recurrence had taken place. Based on these studies it appears that repair failure is not due to a single cause. Rather, a variety of mechanisms such as dilatation of reconstructed valve site (axillary vein transfer), late stenosis, or postthrombotic destruction account for the failure of the repair.

Dr. Imparato. Well, you have not answered my question. Did you look at the operative site to see whether the veins curled, whether they fibrosed, whether the venous wall dilated, whether the sutures tore through? Unless you know the mechanism of failure, it is pointless to keep doing these procedures when you do not know what you are trying to prevent. You obviously did not look at them, that is what I am getting at.

Dr. Raju. Well, it is difficult to go back in a repaired valve site. The fibrotic reaction makes it fairly difficult. And after having tried two or three, one does not want to go back at the repaired valve site.

In the two or three that were reoperated at the exact same site, the mechanism of failure varied by such a small number it would not be appropriate to draw conclusions. Like a failed bypass repair, when you have to redo a repair, the approach would be to go to your fresh site to try and repair another valve if a redo valve repair is required. Again, the incidence was pretty low, only 4% redoes.