Comparison of the Sheath Delivery System Versus Bare Stenting for Coronary Stent Implantation

Shunji Kasaoka,1 MD, Rirei Son,1 MD, Mahmoud Eslami,1 MD, Clare Pierman,2 AAS, Jesse Currier,2 MD, Lawrence A. Yeatman,2 MD, and Jonathan M. Tobis,1,2* MD

Outside the United States, Palmaz-Schatz coronary stents are implanted by hand-crimping the stent to a high pressure balloon without the use of a protective sheath. This lowers the delivery profile, increases the ease of deployment, and ensures that the postdilatation balloon is centered on the stent. To assess this bare stenting technique, 209 patients were retrospectively analyzed: 92 patients (107 lesions) with the sheath-protected stent delivery system (SDS) and 117 patients (150 lesions) with the bare stent approach. The number of balloons used per lesion in the bare stent group was significantly less than in the SDS group (1.9 ± 0.6 vs. 3.8 ± 1.2, P < 0.0001). In addition, the procedure time in the bare stent group was significantly shorter than in the SDS group (106 ± 55 vs. 134 ± 60 min, P = 0.001). There was no difference in frequency of adverse events or stent displacement during the procedure. The bare stenting technique decreases the procedure time, reduces the number of balloons used, and is as safe as the SDS approach. Cathet. Cardiovasc. Diagn. 43:386–394, 1998. © 1998 Wiley-Liss, Inc.

Key words: coronary stents; stent delivery system; bare stenting

INTRODUCTION

In recent years, a variety of intracoronary stents has been developed that offer a valuable nonsurgical approach to the management of acute complications of failed angioplasty and to reduce restenosis compared with percutaneous transluminal coronary angioplasty [1,2]. The most commonly used stent system in the United States is the Palmaz-Schatz coronary stent (Cordis, a Johnson & Johnson Company, Miami Lake, FL). This stent has two slotted tubular segments joined by a single filament and is delivered with a sheath-protected stent delivery system [2]. Despite its successful clinical use, the Palmaz-Schatz stent is relatively bulky and inflexible, and is difficult to place in tortuous vessels. Outside the United States, to overcome these drawbacks, the majority of Palmaz-Schatz stents are implanted by hand-crimping the stent to a high pressure balloon without the use of a protective sheath [3,4]. This lowers the delivery profile, increases the ease of deployment, and ensures that the postdilatation balloon is centered on the stent. The purpose of the present study was to retrospectively evaluate the benefit and safety of the bare stenting technique as practiced in one center in the United States.

METHODS

Patients

From March 1995 through February 1997, 226 consecutive patients with 291 lesions were treated with intracoronary stents by two operators. The stent delivery system (SDS) was used until October 1996; after this period, all patients received stents that were removed from the SDS and hand-crimped to a high pressure balloon. We retrospectively analyzed 209 patients with 257 lesions that were treated with Palmaz-Schatz stents. The other 17 patients were excluded because they received Gianturco-Roubin stents (Cook Inc., Bloomington, IN). Patients were classified into two groups: 117 patients (150 lesions) with the bare stent technique (bare stent group) and 92 patients (107 lesions) with the sheath-protected stent delivery system (SDS group). The clinical characteristics of study patients are shown in Table I.

Stent Implantation Procedure

In the SDS group, Palmaz-Schatz stents were delivered with a sheath-protected stent delivery system according to the manufacturer’s instructions. In the bare stent group, the stent was hand-crimped to a high pressure balloon without a sheath. The number of balloons used per lesion was significantly less in the bare stent group (1.9 ± 0.6 vs. 3.8 ± 1.2, P < 0.0001). In addition, the procedure time was significantly shorter in the bare stent group (106 ± 55 vs. 134 ± 60 min, P = 0.001). There was no difference in frequency of adverse events or stent displacement during the procedure. The bare stenting technique decreases the procedure time, reduces the number of balloons used, and is as safe as the SDS approach.

Contract grant sponsor: NIH; Contract grant number: R01-HL45077.

*Correspondence to: Jonathan M. Tobis, MD, Department of Medicine/Cardiology, University of California, Irvine, Irvine, California, 101 The City Drive South, Orange, CA 92868-3298. E-mail: jmtobis@uci.edu

© 1998 Wiley-Liss, Inc.
coronary artery, MI

coronary artery, LCX

A short segment wire was advanced into the distal end on the balloon catheter to stiffen the catheter and to prevent collapse of the inner lumen when the stent was crimped. The balloon catheter was then advanced over the guidewire and a final crimping was performed prior to insertion into an 8F guiding catheter. Examples of a hand-crimped bare stent or a preloaded SDS are shown in Figure 1. The diameter of a crimped bare stent on an NC Bandit® 3.5 mm balloon or an SDS with a 3.0 mm balloon were measured by a micrometer five times and averaged. The mean diameter of the hand-crimped bare stent was 0.5 mm smaller than the SDS (1.3 mm vs. 1.8 mm).

A single stent was defined as one full-stent or one half-stent implantation. The number of balloons per lesion was defined as the sum of dilatation balloons used to predilate, deliver the stent, or postdilate the stent. The number of balloons per stent was calculated as the number of balloons per lesion divided by the number of stents per lesion. In the bare stent group, the stents were delivered with one of the dilatation balloons and frequently the same balloon was used to predilate, deliver the stent, and then expand it at high pressures. Procedure time was defined as the period that the patient entered and exited the catheterization laboratory.

The dictated procedure notes were reviewed retrospectively to determine the incidence of difficult stent deliveries. This was defined as significant resistance in getting the stent to the lesion which required extra time, a different guidewire or special manipulation.

Adverse events were defined as intraprocedural complications during the coronary intervention, including stent displacement. Stent displacement was defined as stent dislodgement from the balloon catheter in an unexpected place.

**Statistical Analysis**

Statistical analysis was performed on a Power Macintosh 8500 with a commercially available software program (Statview 4.5, Abacus Concept Inc., Berkeley, CA). Values were expressed as mean ± standard deviation (SD). Differences between groups were evaluated by chi-square analysis (two-way table or multiple proportions test) or Fisher exact test for categoric variables and by t-test for continuous variables. \( P \) values <0.05 were considered significant.

**RESULTS**

**Clinical Characteristics**

There were no differences in mean age, gender, lesion site, or the number of treated lesions per patient in the two groups. However, PTCA for acute myocardial infarction was more frequent in the bare stent group than in the SDS group (25% vs. 13%, \( P < 0.05 \)).
Figure 1.
Procedural Characteristics

There were 192 stents successfully deployed in the bare stent group, and 151 stents in the SDS group. As shown in Table II, there were no significant differences in the number of stents used per lesion or the frequency of lesions treated with a Rotablator® (SCIMED, Boston Scientific Corp., Maple Grove, MN) prior to stent placement. A half-stent was used in six lesions (4%) in the bare stent group and three lesions (3%) in the SDS group ($P = 0.45$). In the SDS group, the half-stents were remounted on the stent delivery system after cutting the stent at the articulation. A single stent was used in 109 lesions (73%) in the bare stent group and in 69 lesions (66%) in the SDS group ($P = 0.24$). However, the mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 \pm 0.6$ vs. $3.8 \pm 1.2$, $P < 0.0001$). Even if the balloon used with the SDS is discounted, the mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 \pm 0.6$ vs. $2.4 \pm 0.7$, $P < 0.0001$). If the number of balloons is counted per lesion instead of per stent, the number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 \pm 0.6$ vs. $3.8 \pm 1.2$, $P < 0.0001$). Even if the balloon used with the SDS is discounted, the mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 \pm 0.6$ vs. $2.4 \pm 0.7$, $P < 0.0001$). If the balloon used with the SDS is discounted, the mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 \pm 0.6$ vs. $2.4 \pm 0.7$, $P < 0.0001$).

Table II shows the procedural characteristics in the two groups. Intravascular ultrasound (IVUS) guidance for stent deployment was used in 20% of the patients in the bare stent group versus 70% in the SDS group ($P < 0.0001$). The procedure time in the bare stent group was significantly shorter than in the SDS group (106 ± 55 vs. 134 ± 60 min, $P = 0.001$). In addition, fluoroscopy time in the bare stent group was 29% shorter than in the SDS group (29 ± 17 vs. 41 ± 22 min, $P < 0.0001$). There was no difference in total contrast volume used in the two groups.

**Fig. 1. A:** Palmaz-Schatz stent with a sheath delivery system. The measured diameter of this stent delivery system with a 3.0 mm balloon was 1.8 mm. **B:** Palmaz-Schatz stent manually mounted on an NC Bandit® 3.5 mm balloon (“bare stent”). The diameter of this mounted bare stent was 1.3 mm.

### Table II. Comparison of Procedural Characteristics*

|                            | Bare Stent Group | SDS Group | $P$ Value |
|-----------------------------|------------------|-----------|-----------|
| Number of stents per lesion |                  |           |           |
| Mean ± SD                   | 1.3 ± 0.5        | 1.4 ± 0.7 | 0.21      |
| 1 half                      | 4 (3%)           | 1 (1%)    | 0.32      |
| 1 full                      | 105 (70%)        | 68 (65%)  | 0.39      |
| 1 full + 1 half             | 2 (1%)           | 2 (2%)    | 0.54      |
| 2 full                      | 35 (24%)         | 22 (21%)  | 0.66      |
| 3 full                      | 3 (2%)           | 10 (10%)  | 0.01      |
| 4 full                      | 0                | 1 (1%)    | 0.41      |
| Number of balloons per lesion |                |           |           |
| Mean ± SD                   | 1.9 ± 0.6        | 3.8 ± 1.2 | <0.0001   |
| 1                           | 37 (25%)         | 0         | <0.0001   |
| 2                           | 94 (63%)         | 7 (7%)    | <0.0001   |
| 3                           | 18 (12%)         | 46 (44%)  | <0.0001   |
| ≥4                          | 0                | 51 (49%)  | <0.0001   |
| Maximal balloon size (mm)   | 3.3 ± 0.4        | 3.5 ± 0.4 | <0.0001   |
| Maximal inflation pressure  |                  |           |           |
| ≤16 atm                     | 20 (13%)         | 9 (10%)   | 0.42      |
| ≥16 atm                     | 129 (87%)        | 91 (90%)  | 0.42      |
| IVUS guidance               | 23 (20%)         | 64 (70%)  | <0.0001   |
| Rotablator used             | 33 (28%)         | 21 (23%)  | 0.43      |
| Procedure time (min)        | 106 ± 55         | 134 ± 60  | 0.001     |
| Fluoroscopy time (min)      | 29 ± 17          | 41 ± 22   | <0.0001   |
| Total contrast used (ml)    | 373 ± 198        | 385 ± 179 | 0.67      |

*IVUS = Intravascular ultrasound.

### Single Stent Placement

Table III shows the procedural characteristics in the patients who were treated with a single stent in only one lesion. The mean number of balloons used in the bare stent group was significantly less than in the SDS group ($1.9 ± 0.5$ vs. $3.2 ± 0.7$, $P < 0.0001$). Even if the balloon used with the SDS is discounted, the mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group ($1.9 ± 0.5$ vs. $2.4 ± 0.7$, $P < 0.01$). The incidence of using only a single balloon was 25% per lesion or 44% per stent in the bare stent group. The maximal balloon size in the SDS group was significantly larger than in the bare stent group ($3.5 ± 0.4$ vs. $3.3 ± 0.4$ mm, $P < 0.0001$). There was no difference in the frequency of high pressure ($≥16$ atm) inflations in the two groups. Intravascular ultrasound (IVUS) guidance for stent deployment was used in 20% of the patients in the bare stent group versus 70% in the SDS group ($P < 0.0001$). The procedure time in the bare stent group was significantly shorter than in the SDS group ($106 ± 55$ vs. $134 ± 60$ min, $P = 0.001$). In addition, fluoroscopy time in the bare stent group was 29% shorter than in the SDS group ($29 ± 17$ vs. $41 ± 22$ min, $P < 0.0001$). There was no difference in total contrast volume used in the two groups.

### Difficulty of Stent Delivery

As shown in Table IV, it was difficult to deliver nine of 192 stents (4.7%) in the bare stent group, which included...
five stents delivered through a nonstented but tortuous artery and four stents delivered through a prior proximal stented lesion. Only one of these stents could not be deployed successfully. In the SDS group, it was difficult to deliver 11 of 151 stents (7.3%, $P = 0.32$), which included eight stents delivered through a nonstented artery. If the SDS catheter could not be advanced to the lesion, the sheath was withdrawn to reduce the profile and the stent was readvanced. In eight of the nine cases, this resulted in successful deployment. The SDS system was also attempted in two cases to pass through a stent that had just been deployed at a proximal site. This was unsuccessful in both cases, despite attempts to withdraw the sheath. A representative example where the bare stent approach was used after the SDS failed is shown in Figure 2.

Adverse Events

Adverse events during the procedure occurred in four patients in the bare stent group and in six patients in the SDS group (3.4% vs. 6.5%, $P = 0.30$). There was no difference in the incidence of acute occlusion, coronary dissection, coronary perforation, or stent displacement, as shown in Table V. In the bare stent group, two of three displaced stents were successfully retrieved, however, one stent was deployed proximal to the target lesion because it was not able to be retrieved, and then bypass surgery was performed. In the SDS group, one stent was dislodged after the sleeve was withdrawn and was deployed proximal to the target lesion. There was no case of stent embolization to the systemic circulation in either group.

Subset Analysis of Cases Without IVUS Guidance

Table VI shows the procedural characteristics in the cases where IVUS guidance was not used. The mean number of balloons used per lesion in the bare stent group was significantly less than in the SDS group (1.9 ± 0.6 vs. 3.6 ± 0.9, $P < 0.0001$). The mean number of balloons used per stent in the bare stent group was significantly less than in the SDS group (2.6 ± 0.6 vs. 2.6 ± 0.5, $P < 0.0001$). There was no significant difference in the procedure time in the two groups, however, the fluoroscopy time in the bare stent group was significantly shorter than in the SDS group (27 ± 17 vs. 37 ± 24 min, $P < 0.05$).

DISCUSSION

Although Palmaz-Schatz stents are beneficial in treating coronary artery lesions, the ease of deployment with the current system is less than optimal. Schatz et al. [5] reported that failed delivery occurred with 22 of the 321 stents (six of 30 prototype rigid stents and 16 of 291 articulated stents) without a protective sheath delivery system. Of these stents, 11 were successfully withdrawn, three were deployed proximal to the target lesion, and eight embolized systemically during attempted withdrawal into the femoral sheath without clinical sequelae. Because of concern over stent dislodgement from the balloon and stent embolization, a sheathed delivery system was developed to protect the stent until it was positioned at the intended site [6].

Despite their utility, the stents currently available in the United States have many limitations associated with their length and rigidity, making deployment in calcified or tortuous vessels difficult. Although clinical studies have demonstrated that the procedural success rate of Palmaz-Schatz coronary stent placement was significantly higher than balloon angioplasty [1,2], the Benestent and STRESS

---

**TABLE III. Procedural Characteristics in the Patients Treated With a Single Stent***

| Parameter                        | Bare Stent Group | SDS Group | $P$  |
|----------------------------------|------------------|-----------|------|
| Number of patients               | 56 (48%)         | 45 (49%)  |      |
| Number of balloons               | 1.9 ± 0.5        | 3.2 ± 0.7 | <0.0001 |
| Procedure time (min)             | 85 ± 49          | 108 ± 56  | 0.04 |
| Fluoroscopy time (min)           | 24 ± 16          | 32 ± 22   | 0.03 |
| Total contrast used (ml)         | 342 ± 211        | 304 ± 149 | 0.33 |
| IVUS guidance                    | 12 (21%)         | 34 (75%)  | <0.0001 |

*IVUS = Intravascular ultrasound.

---

**TABLE IV. Frequency of Difficult Stent Delivery**

| Parameter                        | Bare Stent Group (n = 192) | SDS Group (n = 151) | $P$  |
|----------------------------------|-----------------------------|---------------------|------|
| Total number of difficult stents  | 9 (4.7%)                    | 11 (7.3%)           | 0.32 |
| Unsuccessful deployments         | 1 (0.5%)                    | 3 (2.0%)            | 0.32 |
| I) Stent delivered through a non-stented artery |                  |                     |      |
| Number of difficult stent deployments | 5 (2.6%)                 | 9 (6.0%)            | 0.12 |
| Successful deployment            |                            |                     |      |
| Unsuccessful deployment          | 0                           | 1 (0.7%)            | 0.44 |
| II) Stent delivered through a deployed stent to a distal site |  |                     |      |
| Number of difficult stent deployments | 4 (2.1%)                 | 2 (1.3%)            | 0.59 |
| Successful deployment            | 3 (1.6%)                    | 0                   | 0.26 |
| Unsuccessful deployment          | 1 (0.5%)                    | 2 (1.3%)            | 0.59 |
trials showed that stent placement failed in 10 of 259 patients (3.9%) and three of 205 patients (1.5%), respectively, because of an inability to cross the lesion. To facilitate stent delivery in difficult cases, several reports describe that cutting the Palmaz-Schatz stent in half has several advantages [4,7–9]. The half-stent can be re-mounted on the stent delivery system to increase the SDS flexibility and still maintain the safety of the delivery sheath [10,11].

In an attempt to address the problem of difficult stent delivery, investigators outside the United States can purchase Palmaz-Schatz stents without the sheathed stent delivery system [3]. The stents are then hand-crimped to a low profile, high pressure balloon which facilitates passing the stent through tortuous arterial segments. Alternatively, the stent can be cut in half and the 7 mm long section is crimped to the balloon to improve delivery through a tortuous segment or to a distal lesion through a previously deployed stent. The potential problem with this bare stenting approach is that the unprotected stent could slide off the balloon and remain in the coronary artery proximal to the intended lesion or embolize during attempted retrieval. Colombo et al. [3] reported that embolization of a stent occurred in four of 100 patients (two in a coronary artery, two in a peripheral artery) during bare stent implantation. However, the incidence of major problems encountered during stent implantation tends to decrease with operator experience [3,5]. Recently, Levine et al. [12] reported that the bare stent method was successful in 15 of 18 attempts after an SDS approach failed to deliver the stent to the lesion. An accompanying editorial cautioned that “bare stenting cannot be . . . openly endorsed as a replacement for the standard stent delivery system . . . .”

Our study suggests that from a technical standpoint, bare stenting is as safe as the SDS technique and has definite advantages in ease of delivery, use of fewer balloons, and less fluoroscopy time.

**Benefit and Safety of Bare Stent**

In the present study, there were significant differences between the bare stent group and the SDS group in the number of balloons used per lesion or per stent. In addition, the frequency of using only a single balloon to predilate the lesion, deliver the stent, and expand it at high pressure in the bare stent group was significantly higher than the SDS group (25% vs. 0%, \( P < 0.0001 \)). Even if the balloon that comes with the stent delivery system is discounted, the number of balloons used per lesion was significantly less in the bare stent group than in the SDS group (1.9 ± 0.6 vs. 2.4 ± 0.7, \( P < 0.0001 \)). These results suggest that the bare stent technique may reduce the cost of intracoronary stent implantation.

Another method to decrease the number of balloons is to use IVUS imaging before an intervention to choose the appropriate size balloon to predilate and postdilate the stent [14,15]. On the other hand, IVUS guidance may account for an increase in the number of balloons used after deployment in an attempt to optimize stent expansion. To account for the effects of performing IVUS studies, a subset analysis was performed (Table VI). Although limited by a smaller sample size, this analysis of the cases without IVUS guidance demonstrates that there was still a significant difference in the number of balloons used in the two groups.

Although using a bare stent approach requires extra time to mount and crimp a stent on a balloon, the total procedure and fluoroscopy time were less in the Bare stent group. One explanation for this is the ease of delivery and positioning of the balloon and stent which required less exchanges for different balloons or less manipulation than is required with the SDS method. Knowing that the balloon is centered on these nonradiopaque stents, provides confidence for the operator to immediately deploy the stent at high pressures. The use of IVUS imaging could have increased the procedure time in the SDS group where IVUS was used more frequently. The subset analysis of the cases without IVUS guidance (Table VI) indicates that the procedure time in the bare stent group was slightly shorter than in the SDS group, but was not statistically significant for this smaller cohort. Fluoroscopy time was still significantly shorter in the Bare stent group without IVUS imaging.

In the present study, stent displacement in the bare stent group occurred in three of 117 patients (2.6%), however, there was no difference compared with the SDS group (one of 92 patients, 1.1%). In addition, there was no case of stent embolization to the systemic circulation in the bare stent group. The incidence of major problems encountered during stent implantation tend to decrease with operator experience. These results suggest that the bare stent technique is as safe as the approach with a sheath-protected stent delivery system.

**Difficulty of Stent Delivery**

Although there was no significant difference between the two groups in the incidence of difficult stent delivery, there was a tendency for more difficult delivery in the SDS group than in the bare stent group for stents deployed through nonstented tortuous arteries (6.0% vs. 2.7%, \( P = 0.12 \)). The number of cases where it was attempted to pass a stent through a previously stented site was limited, however this was successful in three of the four cases with the bare stent approach, but was unsuccessful in the two cases with the SDS method. After a failed attempt to advance the stent into a coronary artery, the
stent should be deployed proximally or retrieved with care. Although no serious sequelae of stent embolization have been described, the potential remains for life-threatening complications, such as stent embolization to the cerebrovascular circulation with thrombosis. Kieme-neij et al. [16] recommended two strategies to prevent stent loss or embolization: one was to deploy the stent proximal to the target lesion, and the other was to withdraw the entire system (guiding catheter and stent-loaded balloon catheter) into the peripheral artery.

**Study Limitations**

There are several limitations to the present study. This was a retrospective, nonrandomized study of two sequen-
TABLE VI. Procedural Characteristics in the Patients Without IVUS Guidance

|                                | Bare Stent Group | SDS Group | P Value |
|--------------------------------|------------------|-----------|---------|
| Number of lesions              | 120              | 32        |         |
| Number of balloons per lesion  |                  |           |         |
| Mean ± SD                      | 1.9 ± 0.6        | 3.6 ± 0.9 | <0.0001 |
| Number of balloons per stent   |                  |           |         |
| Mean ± SD                      | 1.6 ± 0.6        | 2.6 ± 0.5 | <0.0001 |
| Procedure time (min)           | 99 ± 55          | 108 ± 58  | 0.53    |
| Fluoroscopy time (min)         | 27 ± 17          | 37 ± 24   | 0.03    |

The use of the bare stenting technique or sheathless method of deploying Palmaz-Schatz coronary stents decreases the procedure time, reduces the number of balloons used, and is as safe as the approach with a sheath-protected stent delivery system. The smaller diameter of the bare stent may permit the use of smaller guiding catheters such as 7F or 6F. Although low profile, sheathless systems are currently available outside the United States, it is uncertain when these stents will be permitted in this country. If the SDS approach is unsuccessful, this bare stenting technique may be a useful alternative until the newer stents are available.

REFERENCES

1. Serruys PW, de Jaegere P, Kiemeneij F, Macaya C, Rutsch W, Heyndrickx G, Emanuells H, Marco J, Legrand V, Materne P: A comparison of balloon-expandable-stent implantation with balloon angioplasty in patients with coronary artery disease. Benestent Study Group. N Engl J Med 331:489–495, 1994.
2. Fischman DL, Leon MB, Baim DS, Schatz RA, Savage MP, Penn J, Detre K, Veltri L, Ricci D, Nobuyoshi M: A randomized comparison of coronary-stent placement and balloon angioplasty in the treatment of coronary artery disease. Stent Restenosis Study Investigator. N Engl J Med 331:496–501, 1994.
3. Colombo A, Maiello L, Almagor Y, Thomas J, Zerboni S, Di Summa M, Finci L: Coronary stenting: single institution experience with the initial 100 cases using the Palmaz-Schatz stent. Cathet Cardiovasc Diagn 26:171–176, 1992.
4. Colombo A, Hall P, Thomas J, Almagor Y, Finci L: Initial experience with the disarticulated (one-half) Palmaz-Schatz stent: a technical report. Cathet Cardiovasc Diagn 25:304–308, 1992.
5. Schatz RA, Baim DS, Leon M, Ellis SG, Goldberg S, Hirshfeld JW, Cleman MW, Cabin HS, Walker C, Stagg J: Clinical experience with the Palmaz-Schatz coronary stent. Initial results of a multicenter study. Circulation 83:148–161, 1991.
6. Carrozza J, Kuntz RE, Levine MJ, Pomerantz RM, Fishman RF, Mansour M, Gibson CM, Senerchia CC, Diver DJ, Safian RD: Angiographic and clinical outcome of intracoronary stenting: intermediate and long-term results from a large single-center experience. J Am Coll Cardiol 20:328–337, 1992.
7. Mehan VK, Kaufmann U, Salzmann C, Meier B: Use of half (disarticulated) Palmaz-Schatz stents for thrombus-containing coronary lesions. Cathet Cardiovasc Diagn 33:370–372, 1994.
8. Mehan VK, Kaufmann U, Urban P, Chatelain P, Meier B: Stenting with the half (disarticulated) Palmaz-Schatz stent. Cathet Cardiovasc Diagn 34:122–127, 1995.
9. Koh TH: Method of preparing, mounting, and implanting a Palmaz-Schatz coronary half-stent from the stent delivery system. Cathet Cardiovasc Diagn 36:164–170, 1995.
10. Satler LF: Editorial comment. Use of half stents. Cathet Cardiovasc Diagn 35:171–172, 1995.
11. Feldman T, Kabour A, Carroll JD, Levin TN: Improved technique for use of half-stents remounted on a stent delivery system. Cathet Cardiovasc Diagn 39:17–20, 1996.
12. Levine G, Khan MM, Kleiman NS, Raizner AE, Jeroudi MO, Mickelson J, Ali MN: Use of bare-mounted Palmaz-Schatz stents employing the stent saddle technique on the delivery balloon: A single center experience. Cathet Cardiovasc Diagn 41:361–368, 1997.
13. Topaz O: Bare-mounted stents: A bare necessity? [editorial; comment]. Cathet Cardiovasc Diagn 41:369–370, 1997.
14. Mintz GS, Pichard AD, Kovach JA, Kent KM, Satler LF, Javier SP, Popma JJ, Leon MB: Impact of preintervention intravascular ultrasound imaging on transcatheter treatment strategies in coronary artery disease. Am J Cardiol 73:423–430, 1994.
15. Colombo A, Hall P, Nakamura S, Almagor Y, Maiello L, Martini G, Gaglione A, Goldberg SL, Tobis JM: Intracoronary stenting without anticoagulation accomplished with intravascular ultrasound guidance. Circulation 91:1676–1688, 1995.
16. Kiemeneij F, Laarman GF: Transradial artery Palmaz-Schatz coronary stent implantation: Results of a single-center feasibility study. Am J Cardiol 130:14–21, 1995.