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A Survey of Patient Preference for Insulin Jet Injectors Versus Needle and Syringe

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Many studies have tested the insulin absorption rate and mechanical reliability of jet injectors. However, no published papers have dealt exclusively with patient preference for this method of administering insulin over a period of years. This paper reports the results of a survey done to determine if use of a jet injector for delivering insulin has an effect on acceptance of and adherence to a regimen of multiple doses of insulin. Over the past 15 years, the authors have instructed approximately 70 patients to use various jet injectors. A questionnaire was developed and sent to 75 patients. Of these, 42 completed and returned the questionnaire. Survey results indicate that even though some problems with the injectors were identified, 70% of those responding still preferred to take insulin by jet injector.

Many patients with insulin-dependent diabetes mellitus (IDDM) maintain precise control of blood glucose levels by multiple daily injections of insulin in an attempt to reduce the complications of diabetes.¹⁻³ This practice has led to the exploration of less painful and more acceptable methods of insulin delivery than the standard needle and syringe. The treatment of diabetes has become increasingly complicated and can be burdensome on many aspects of daily life.⁴ Jet injection may be a more acceptable method of multiple insulin injections.⁵

Achieving good control of blood glucose levels is important but may be hindered by the patient's reluctance to administer insulin three or four times a day by needle and syringe. Also, synchronizing carbohydrate and insulin absorption may be a concern.⁶

According to the 1988 American Diabetes Association (ADA) position statement on patient injectors, jet injection appears to offer a mechanically reliable and accurate alternative to syringe injection, and the ADA advocates further study of these instruments.⁷

In 1978, Danowski and Sunder² studied five patients who used the Syrijet injector (Mark IV, Mizzy Inc, Clifton Forge, Va) from 1 to 5 years. These authors concluded that the administration of insulin by jet injection lightened the burden of multiple daily doses of insulin. In addition, according to Danowski, the jet injector permits the user to reach previously inaccessible insulin administration sites, eg, upper area of arm and buttocks.

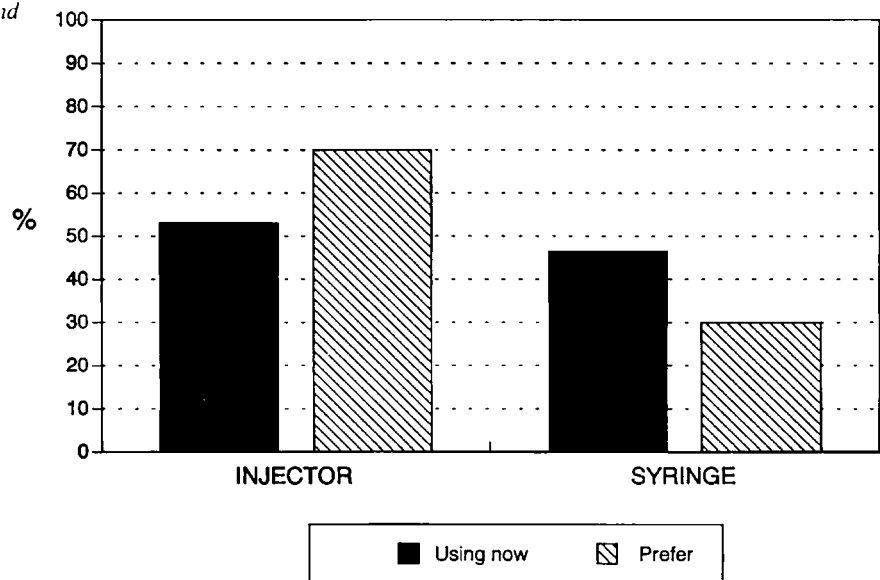
In 1980, Worth and colleagues⁶ conducted a study on 13 IDDM patients aged 17 and 18. The device used was the Med-e-jet (Med-e-jet Limited, Wexham, Clwyd, Wales). Scores were assigned for immediate pain, delayed pain, bleeding, and insulin leakage. Overall, 6 patients preferred the needle and syringe, 4 preferred the jet injector, and 3 were ambivalent.⁶

In a study to measure insulin absorption, Halle et al⁵ noted that because of pain and psychological aversion to needles, some patients were reluctant to inject themselves several times daily. They suggested that an insulin injector may improve patient compliance to a multiple injection protocol. The investigators concluded that insulin absorption is more rapid with the injector and recommended slight adjustments

An abstract of these findings appeared in *Diabetes* 1990;39(Suppl 1): 213A.

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Fig 1. Current usage versus injector and syringe preference.



of the insulin dosage when switching from the syringe to the injector.

Lindmayer et al⁸ tested the Preci-Jet (Advanced Medical Technologies, Charlottetown, Prince Edward Island, Canada) and concluded that this jet injector is accurate and reliable and could prove to be a practical tool for diabetic patients. Skyles⁹ reported negative findings when he and four other staff members gave themselves saline injections by jet in 1979. Four of the five developed bruises and/or lacerations, hence they never pursued further use of the jet injectors.

None of these studies was performed strictly from the user's perspective. This survey was conducted to determine patient acceptance and preference for taking insulin by jet injection and its effect on various aspects of daily life. We also wanted to see if use of a jet injector had any effect on adherence to the person's diabetes treatment program.

Materials and Methods

To evaluate the patients' preferred method of insulin delivery (needle and syringe versus the jet injector), we developed a questionnaire of 36 closed-ended questions covering basic data (18), opinion (11), and choice (7). These questions were answered by placing a check mark next to the appropriate answer. Some questions allowed for more than one response. We also included one open-ended question asking patients to tell us about any problems, concerns, or opinions they had about their use of the injector.

The questionnaire was approved by our hospital's Human Investigation Committee. It was designed to maintain anonymity and included a separate consent form that we asked the recipients to return separately from the questionnaire itself. Several physicians on staff contacted their patients who had experience using an injector, and we received permission to send questionnaires to them.

Forty-two completed questionnaires were returned to us. The population who responded included 26 men and 16 women between the ages of 20 and 53 years, with an average age of 35 ± 8 years of age.

The onset of diabetes occurred before age 21 in 28 people (74%), and 30 people (77%) began using the jet injector at age 21 or older.

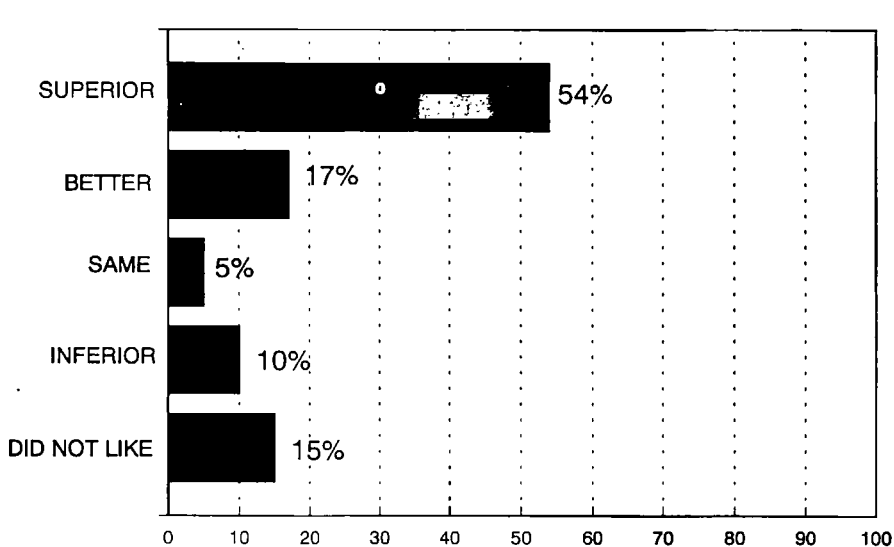
All of the respondents used a needle and syringe for insulin administration prior to using an injector. Twenty-seven (69%) used a needle and syringe from 5 to 30 years before switching to the jet injector. The other 15 patients (31%) used a needle and syringe for less than 5 years.

Results

Although 46% of respondents are now using a needle and syringe rather than an injector for insulin administration, 70% of those surveyed indicated they prefer the jet injector (Fig 1). Fifty percent of those who stopped using the injector did so because the injector was broken. Broken injectors and lack of knowledge about the availability of jet injectors may account for this disparity between usage and preference. As shown in Figure 2, 54% actually find the injector superior to the needle and syringe; 17% find it better; 15% said they did not like the injector; and 10% found it an inferior method of insulin delivery. Of those who stopped using the injector (20 responses), 45% did so because they did not like it and 5% because they were told to stop by a nurse or physician.

Table 1 compares insulin usage. A notable difference was found in the number of injections of insulin taken daily by injector users and by needle and syringe users. Eighty-four percent of injector users take insulin four times daily while only 26% of those using the conventional syringe take insulin four times daily. There is essentially little difference between types of insulin used, total daily dosage (Table 2), and injection sites (Table 3). Even though preference for the injector is high, a majority (62%) feel that some insulin is lost with the injector but not with the syringe. Most respondents estimate the loss to be 1 to 2 units per injection. When asked if they thought the perceived loss of insulin was a problem in controlling their diabetes, 68% of the respondents said no. Fifty-nine percent felt that they can control their diabetes better using the jet injector.

Respondents reported that the jet injector has made some



aspects of their life-style easier. Forty-two percent felt that taking insulin at school or work was easier with the jet injector. Twelve percent were less concerned with having low blood glucose levels; 30% reported less pain and discomfort with the jet injector; 16% said that taking insulin by jet injector was more acceptable because no needle is involved; and 69% felt that it has helped them adhere to their diabetes regimen. Cost did not appear to be a problem because 85% said that cost did not delay their obtaining the injector.

Discussion

Our experience with the use of the jet injector began in 1972 when we instructed two young men in multiple insulin administration by jet injection. The next group of patients included teenagers and young adults who began using the jet for multiple injections in 1976. Since that time, our experience has included use of the Syrijet Mark IV (Mizzy Inc, Clifton Forge, Va), the Preci-Jet 50 (Advanced Medical Technologies, Inc, Charlottetown, Prince Edward Island, Canada), and the Medi-Jector (Derata Corporation, Minneapolis, Minn). The certified diabetes educators in the Department of Endocrinology have instructed approximately 70 patients over a 14-year period.

Patient and family instruction was done on a one-to-one basis. The patient practiced using the injector by administering injections of sterile normal saline. This method allowed the patient to become comfortable in handling the injector before initiating insulin administration. It was felt that allowing the patient to become familiar and comfortable with handling the device before actually administering insulin would reduce anxiety, increase acceptance of the instrument, and prevent errors in dosage that could contribute to hypo- or hyperglycemia.

The experience of most of the patients surveyed has been with the Mizzy Syrijet (Fig 3). This injector (which is no longer available) required filling a glass cartridge with insulin and placing it in the injector. Negative features about this injector included its large size; the necessity of having two instruments because of a reservoir with an unknown volume,

Table 1. Comparison of Type of Insulin Administration by Number of Injections per Day and Type of Insulin Used

Insulin Usage	Injector	Syringe
Times per day		
One	0%	28%
Two	8	49
Three	8	3
Four	84	26
Type of insulin		
NPH	32	42
Lente	16	16
Regular	44	39
Other	4	3

Table 2. Comparison of Type of Insulin Administration by Total Daily Dosage

Dosage Units	Injector	Syringe
2-20 U	3%	5%
21-40 U	44	46
41-60 U	36	31
61-80 U	10	8
> 80 U	8	10

Table 3. Comparison of Type of Insulin Administration by Injection Site

Site	Injector	Syringe
Arm	6%	17%
Abdomen	29	21
Thigh	24	24
Buttock	16	9
All sites	26	28

Fig 3. *Syrijet Mark IV (Mizzy Inc, Clifton Forge, Virginia).*



Fig 4. *Medi-Jector EZ (Derata Corp, Minneapolis).*



Fig 5. *Preci-Jet 50 (Advanced Medical Technologies, Charlottetown, Prince Edward Island, Canada).*



which precluded mixing insulins; bruising; bleeding from the injection site; and splashing, with a loss of insulin.

To relieve anxiety about the loss of insulin, Danowski and Sunder² conducted splash studies to determine the amount of insulin lost during an injection. Perforated filter paper was used for these tests. The aperture of the Syrijet, from which the insulin stream emerges at 2,900 psi, was fitted into a hole in the center of the filter paper disk. The injector and disk were positioned on the patient's abdomen and the insulin injected. A slight weal and a tiny pink dot at the site of the injection and absence of a wet spot on the filter paper indicated that the injection was complete. The magnitude of the loss was estimated by weighing the filter paper before and after the injection. Loss of insulin, when present, was limited to 2% or less of the dose.

The cartridges used in the Mizzy Syrijet are no longer available, so those patients who still have workable instruments have had to find alternative methods of insulin delivery. This accounts for a large number of patients who now use a needle and syringe. However, others have switched to the newer, improved instruments presently on the market.

The injectors currently available (Fig 4, Fig 5) are filled by attaching a special adapter to the insulin vial, which permits the injector to withdraw the correct, preset dose. These injectors allow for adjustments in the pressure setting according to the amount of tissue resistance.¹⁰ This feature lessens the possibility of welts, bruises, and splashing.

Although it was not within the scope of this survey to examine insulin absorption rates and glycosylated hemoglobin test results, 59% of the respondents felt that they can control their diabetes better using the jet injector. This may be explained by the fact that 84% of the injector users take insulin four times a day. Eighty-three percent reported checking their capillary blood glucose levels at least once daily by meter and 53% used their meter four or more times a day.

Although the injection received with the jet injector cannot be described as totally painless, 30% of those responding

reported less pain and discomfort when using the injector than when using a needle and syringe.

Other investigators reported much less success with the use of jet injectors. However, the length of time that the patients in these studies used the injectors could be a contributing factor.^{11,12} The patients who responded to our questionnaire had used a jet injector from 1 to 15 years, with 60% using the injector for more than 7 years.

It was our observation that if parents purchased the injector for their child, often the child refused to use the device. However, if the child initiated the request, he or she was more likely to continue using it.

We also noted that although patients stated that they did not like the injector, they often did not want to resume using a needle and syringe. This could be a choice of the lesser of two evils.

The cost of purchasing the instruments did not seem to be a prohibitive factor because insurance coverage was usually adequate.

We have concluded that despite the apparent disadvantages listed by the respondents, most patients still preferred the injector over the needle and syringe for insulin injection.

The authors wish to thank Ms Joni DenBlyeker, for the patient and professional preparation of this questionnaire and manuscript; the Endocrinology Laboratory, for providing supportive data; and especially the late Thaddeus S. Danowski, MD, whose intellect, expertise, and encouragement inspired us.

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