Evaluation of Femoral Ultrasonography as a Tool for Promoting Cessation of Groin-Injecting Behaviour

Richard Senbanjo^{a, b} John Strang^b

^aEast Kent Drug and Alcohol Recovery Service, Turning Point, Ashford, and ^bNational Addiction Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK

Key Words

Groin injecting · Femoral vein · Ultrasound · Opioid substitution treatment · Behaviour change

Abstract

Aim: To assess the impact of femoral ultrasonography accompanied by explanation of the findings (UFV) on groin-injecting behaviour. **Methods:** 348 heroin-addicted groin injectors (GIs) on opioid substitution treatment (OST) were included in the study: 174 received UFV (cases), 174 did not (controls). Injecting behaviour among cases and matched controls were compared for both 'persistent GIs' (patients who had injected via the femoral vein in the 28-day period preceding the baseline) and 'former GIs' (patients with a history of previous groin injecting). **Findings:** There were no significant between-group differences in gender, mean age, time in treatment, substitute medication and mean dose at baseline or injecting behaviour prior to baseline. After baseline, reduction by a third in the proportion still groin injecting was immediately evident among UFV cases versus controls (number needed to treat: 3, 95% CI: 2, 8; $p < 0.001$). Marked reduction in groin-injecting behaviour among UFV cases was maintained over 12 months, including fewer relapses among 'former GIs' (number needed to treat: 5, 95% CI: 4, 9; $p < 0.001$). **Conclusion:** Single-session UFV may promote cessation of groin-injecting behaviour among patients

receiving OST. This benefit appears to be evident 12 months later. Further evaluation of this novel approach to the management of groin injecting, a particularly harmful behaviour, is now warranted.

© 2015 S. Karger AG, Basel

Introduction

Groin injecting is an emerging social and public health issue in England. Between a third and one half of injecting drug users reportedly use the groin (femoral vein, FV) as their main injecting site [1]. Groin injecting is commoner among older, long-term heroin, cocaine and amphetamine users who no longer have usable surface veins [2, 3]. More recently, younger injecting drug users have increasingly been using the FV because of ease of access, need for concealment of injecting site or perceived superior drug effect [4, 5]. Groin injecting is associated with homelessness, injection of snowball (mixture of heroin and cocaine) and hurried injection in public places [2, 4, 6], all of which carry additional risks.

Groin injectors (GIs) often lack awareness of the risks of vascular damage, bacterial and blood-borne viral infections and overdose death [7–10]. FV damage is associated with deep vein thrombosis with attendant risk of pulmonary embolism [7] and partial or total FV occlusion re-

sulting in chronic venous disease and leg ulcers [11, 12]. Accidental injection into the femoral artery may also lead to arterial spasm, thrombosis or aneurysm requiring limb amputation [13]. Opioid substitution treatment (OST) with methadone or buprenorphine is recognised as effective in helping patients reduce injecting and non-injecting heroin use [14–16]. However, groin injecting often presents as an intractable behaviour which persists despite OST and despite significant resulting FV damage and associated health problems [11, 17].

Previous efforts aimed at reducing injecting complications among OST patients who are still actively injecting in the FV (persistent GIs) have focused on promotion of ‘safer’ groin-injecting practices [2, 18]. There is a dearth of research on any form of intervention to address this problem specifically. Ultrasonography, a first-line diagnostic tool in many medical specialties [19], has only recently started to receive research attention within the addictions field. Ultrasound characteristics of a wide range of groin-injecting complications [9] and the use of ultrasonography for investigation of FV damage among GIs [11] and for bolstering health-affirming messages within drug clinics [20] have been described.

We postulated that engaging GIs in the high-technology procedure of ultrasonography and factual discussions about groin-injecting risks and the state of venous and arterial health at their groin-injecting site(s) might constitute a route transition intervention as previously outlined [21] and consequently lead to reduced groin-injecting behaviour. We now report on the impact of a single-session ultrasound imaging of femoral veins and an explanation of the findings (UFV) in promoting behaviour change among GIs already being treated with OST.

Methods

Design and Participants

A case-control study with a before-and-after design was employed. Participants were heroin-dependent GIs receiving OST (oral methadone or sublingual buprenorphine) from a network of 11 drug clinics in South East England. The drug clinics were managed by the same service provider (KCA UK) and OST was provided under the same clinical policy. Psychosocial support was provided as part of standard care. All GIs received information on the risks of the behaviour and the option of attending a ‘health check’ ultrasound clinic held, in rotation, in each drug clinic. Attendance at the ‘health check’ ultrasound clinics was voluntary and all attendees who received UFV provided informed consent.

Participants, recruited between July 2006 and November 2011, consisted of 174 consecutive attendees at the ‘health check’ ultra-

sound clinics (UFV cases) and 174 matched controls (GIs who did not have UFV). GIs who did not attend the ‘health check’ ultrasound clinic but were in treatment over the same period and receiving the same form of ‘maintenance’ OST as each UFV case were identified from a database. GIs selected as controls were the best available match for each individual UFV case. Matching of cases and controls was done individually based on gender, age, OST medication, time in treatment and whether they were ‘persistent GIs’ or ‘former GIs’ at baseline. Participants contributed data only once.

‘Persistent GIs’ were defined operationally as people who had injected drugs via the FV in the preceding 28-day period. ‘Former GIs’ had previously injected drugs via the FV but had not done so in the preceding 28-day period. The date UFV was performed on each case was set as the ‘baseline’ date for the corresponding control. Previous reports have presented data on early fractions of GIs in the UFV group [11, 17, 20].

The Intervention (UFV)

Screening for Vascular Damage

The ultrasound equipment, operation of the service and the scanning procedure were as previously described [20]. In summary, patients who received UFV were screened for presence of venous or arterial damage and changes in blood flow at the groin-injecting site(s) using real-time and single-frame images, colour blood flow and spectral tracings generated by MicroMaxx™, a portable ultrasound scanner.

Biofeedback of the Findings

Personalised descriptive and visual feedback on what the images portrayed was then provided. Anonymised ultrasound images (from other GIs) showing a range of severity of FV damage were also used to aid communication of groin-injecting risks. Using a non-specific general empathic approach, cases received advice on the need for behaviour change. The ultrasound scanning and biofeedback (UFV) was delivered by the first author (R.S.) with the recovery worker as the ‘chaperone’ and the whole process taking approximately 40 min.

Follow-Up Data

Data extracted from clinical records included duration of drug use, duration of heroin use, duration of injecting, time in treatment, substitute medication and the prescribed dose. Data on injecting behaviour and injecting site were collected over the 12-month periods before and after each baseline date. The 12-month periods were divided into ‘time blocks’ as follows: weeks 0–4, months 2–3, months 4–6, months 7–9 and months 10–12. Injecting on at least one occasion during a ‘time block’ was recorded as a positive event.

Three sections of the clinical records provided information on direct observations of injecting sites and self-reports of injecting behaviour: (1) doctors’ notes (recorded at medical assessment and at 3-monthly medical reviews), (2) care-coordinators’ notes (recorded at initial assessment and at 1- to 4-weekly intervals) and (3) Treatment Outcomes Profile forms [22] (completed at initial assessment and at 3-monthly intervals). Number of times OST was recommenced (after short-term dropout) during the 12-month periods before and after the baseline was also noted. Data were treated as ‘missing’ when patients were ‘not in treatment’ or ‘in prison’ during a time block.

Table 1. Retention in treatment, imprisonment, substitute medication and drug use at baseline among 348 GIs

	Case, n (%)	Control, n (%)	All, n (%)	χ^2	p
<i>Number of times patients 'dropped out' of treatment</i>					
<i>Before baseline (12 months)</i>					
Once	34 (21.1)	31 (18.7)	65 (19.9)	1.64	0.650
Twice	15 (9.3)	12 (7.2)	27 (8.3)		
Three or more times	5 (3.1)	3 (1.8)	8 (2.4)		
<i>After baseline (12 months)</i>					
Once	38 (21.8)	37 (21.3)	75 (21.6)	0.24	0.971
Twice	13 (7.5)	15 (8.6)	28 (8.0)		
Three or more times	7 (4.0)	8 (4.6)	15 (4.3)		
<i>Baseline (UFV date)</i>					
<i>Prescribed medication</i>					
Methadone	160 (92.0)	158 (90.8)	318 (91.4)	0.04	0.977
Buprenorphine	13 (7.5)	14 (8.0)	27 (7.8)		
<i>Drug use</i>					
<i>Heroin</i>					
Intravenous	115 (66.1)	117 (67.2)	232 (66.7)	0.15	0.925
Smoking	15 (8.6)	16 (9.2)	31 (8.9)		
<i>Cocaine (crack or powder)</i>					
Intravenous	42 (24.1)	38 (21.8)	80 (23.0)	3.36	0.186
Smoking	30 (17.2)	44 (25.3)	74 (21.3)		
<i>Amphetamines</i>					
Intravenous	4 (2.3)	4 (2.3)	8 (2.3)	0.00	1.00
Oral	4 (2.3)	4 (2.3)	8 (2.3)		
<i>Benzodiazepine use</i>					
Yes	73 (42.0)	62 (35.6)	135 (38.8)	1.46	0.226
<i>Problem drinking</i>					
Yes	46 (26.4)	44 (25.3)	90 (25.9)	0.60	0.807
There are no significant differences between cases and controls.					

Statistical Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS), version 21 (IBM Corp., USA). Injecting behaviour was initially coded according to injection site ('groin', 'other sites' or 'none') and later recoded as 'groin-injecting behaviour' ('yes' or 'none'). Normally distributed variables were described with means $\pm$ SD. Cases and controls were compared using an independent t test, χ^2 , odds ratio (OR) or number needed to treat with their respective 95% CI. A Mann-Whitney U test was used for non-parametric data. Significance was designated at 95% ($p < 0.05$).

Results

Participant Characteristics

A majority (67.8%) of the 348 study subjects were men and the mean age was 36.0 years (SD 7.4, range 20–56). Mean $\pm$ SD (range) duration of drug use, heroin use and injecting were 21.0 years $\pm$ 7.2 (4–41), 15.7 years $\pm$ 6.7 (2–32) and 13.4 years $\pm$ 7.4 (1–39), respectively.

There were no significant differences between UFV cases and the controls in mean age (36.1 ± 7.6 years vs. 35.9 ± 7.3 , F 0.05, P 0.823), duration of drug use (21.1 ± 7.3 years vs. 21.0 ± 7.0 , F 0.01, P 0.933), duration of heroin use (15.9 ± 6.8 years vs. 15.5 ± 6.5 , F 0.29, P 0.593) or duration of injecting (13.8 ± 7.6 years vs. 13.1 ± 7.3 , F 0.56, P 0.455).

Opioid Substitution Treatment

At baseline, most of the patients (345, 99.1%) were already receiving OST and the remaining 3 (0.9%) were about to commence OST. Median time in treatment was 14.5 months (range 0–137). There were no significant between-group differences in median time in treatment (cases 13.0 months, controls 16.5 months, Z -0.60, p 0.552), number of patients in treatment during each of the 'time blocks' or number of times patients 'dropped out' of treatment in the 12-month period preceding or following the baseline (table 1).

Fig. 1. Line chart showing number of patients who were injecting drugs via the FV (groin injecting) or via other injecting sites (surface veins, subcutaneously or intramuscularly) before and after baseline (intervention date for UFV cases). wks = Weeks; mths = months; Pre = before intervention; Post = after intervention. Significant difference between UFV cases and the controls who were still injecting via the FV after intervention: * $p < 0.01$, ** $p < 0.001$.

Fig. 2. Line chart showing number of 'persistent' vs. 'former' GIs who were actively injecting via the FV before and after the baseline (intervention date for UFV cases). 'Persistent' GIs had injected drugs via the FV in the 28-day period preceding baseline. 'Former' GIs had done so in the past but not in the 28-day period preceding baseline. Significant difference between UFV cases and the controls who were 'persistent' GIs at baseline: * $p < 0.01$, ** $p < 0.001$. Significant difference between UFV cases and the controls who were 'former' GIs at baseline: + $p < 0.05$, ++ $p < 0.01$, +++ $p < 0.001$.

Most patients (318, 91.4%) were receiving methadone, but 27 (7.8%) were on buprenorphine with no significant differences between UFV cases and the controls (table 1). The mean methadone dose was 63.9 mg (SD ± 24.3 , range 11–145) with no significant differences between UFV cases (64.2 ± 24.7 mg, range 11–140) and the controls (63.5 ± 24.0 mg, range 20–145, $F 0.07$, $P 0.791$). The mean buprenorphine dose was 9.8 mg (SD ± 4.9 , range 1.6–16.0) with no significant differences between UFV cases (9.7 ± 4.7 mg, range 3.6–16.0) and the controls (10.0 ± 5.2 mg, range 1.6–16.0, $F 0.03$, $P 0.873$).

Impact of Ultrasound Scanning on Groin-Injecting Behaviour

There were no significant differences between UFV cases and the controls in the prevalence of groin-injecting behaviour over the 12-month period preceding the baseline or at baseline reading (fig. 1). After baseline, however, groin-injecting prevalence reduced by a third (from 56.9 to 36.2%; 99 to 63), a difference which was immediately evident among UFV cases compared with no change (from 56.9 to 56.3%; 99 to 98) among the controls (weeks 0–4: $\chi^2 13.9$, OR 0.44, 95% CI: 0.28, 0.68; $p < 0.001$). The

number needed to treat in order to achieve one groin-injecting cessation within 4 weeks was 3 (95% CI: 2, 8).

The subsequent incremental reductions in groin-injecting behaviour among UFV cases and the controls are shown in figure 1. Compared with the controls, significantly higher rates of behaviour change were observed among the UFV cases.

These marked differences in groin-injecting prevalence were maintained over the 12-month period following baseline (month 12: χ^2 13.0; OR 0.42, 95% CI: 0.26, 0.67; $p < 0.001$). Furthermore, cessation of groin-injecting behaviour was not accompanied by increases in number of patients injecting via other sites among patients in either group (surface veins, subcutaneously or intramuscularly).

Figure 2 shows the results of separate examination of 'persistent GIs' and 'former GIs'. Significant differences were not observed in the proportion of 'persistent GIs' and 'former GIs' in each group over the 12-month period preceding the baseline or at baseline. The association between immediate cessation of groin-injecting behaviour and UFV was observed mainly among 'persistent GIs'. Over the 12-month period following the baseline, OST alone was associated with reductions in groin-injecting behaviour among 'persistent GIs' in the control group. However, the overall beneficial effect of OST in reducing groin-injecting behaviour among patients in the control group was reduced by an increasing proportion of 'former GIs' in the group who recommenced groin injecting (fig. 2).

The observed behaviour change among patients in the UFV group consisted of two components: higher groin-injecting cessation rates among 'persistent GIs' (month 12: χ^2 8.54, OR 2.62, 95% CI: 1.36, 5.05; $p < 0.01$) and also fewer relapses to groin injecting among 'former GIs' (month 12: χ^2 12.30, OR 0.10, 95% CI: 0.02, 0.46; $p < 0.001$). The number needed to treat was 4 (95% CI: 3, 15) in order to achieve one groin-injecting cessation among 'persistent GIs' over 12 months, and 5 (95% CI: 4, 9) in order to prevent one relapse to groin injecting among 'former GIs'.

Discussion

Our hypothesis was that a single-session UFV could be a powerful stimulus for behaviour change among GIs in OST; this appears to be substantiated. Reduction in the proportion still groin injecting was a virtually immediate effect with 3 being the number needed to treat in

order to achieve one groin-injecting cessation within 4 weeks. Furthermore, UFV appears not only to induce durable behaviour change (over a period of 12 months) among 'persistent GIs' but also help 'former GIs' to reduce the likelihood of re-starting groin injecting. Confirmation of these findings in a properly powered randomised control trial is now urgently required in view of the potential for minimisation of groin-injecting harm and healthcare cost savings. Cluster randomisation at clinic or regional level may help limit the diluting effects of peer contacts.

Effectiveness of OST in changing injecting behaviour and in conferring health gains is widely recognised [14–16]. However, there is often persistence of intermittent injecting, thus continuing risk to the individual and others. The observed marked reduction in groin-injecting behaviour suggests that UFV might enhance OST outcomes more generally. Health outcomes were not evaluated in the present study, but improvements in general health and quality of life have previously been shown to accompany cessation of injecting [23]. Transition away from injecting remains a major public health goal as needle and syringe exchange programmes, while considered generally successful with regard to HIV transmission [24], have had limited success in reducing hepatitis C incidence and prevalence among injecting drug users [10].

The findings reported here suggest that GIs already being treated with OST might respond positively to health-affirming messages delivered through UFV. Ultrasound scanning allowed identification of previously unrecognised FV damage. Personalised feedback on existing structural and functional vascular damage may add potency to groin-injecting risk messages. Cognitive and emotional mediators such as knowledge, attitudes, beliefs, peer norms and self-efficacy are probably involved in the process of behaviour change [25]. UFV is perhaps triggering such psychological processes. However, the feedback was not designed around specific psychological methods. Future replication studies might include investigation of psychological framing of the UFV session, perhaps with motivational interviewing methods.

As some individuals will persist with groin-injecting behaviour despite warnings of clinical danger, 'safer groin-injecting interventions' and the training of GIs in peripheral venepuncture techniques have been advocated [2, 18]. Other authors have questioned this approach, arguing instead that groin injecting cannot be carried out safely in view of the associated health risks [5, 26]. While existing harm reduction strategies should continue, UFV

appears to offer a promising approach to tackle groin-injecting behaviour. Adaptations of UFV may also be usefully applied to address other high-risk behaviours such as neck (jugular vein) or armpit (brachial/axillary vein) injecting.

An awareness of the limitations of this study is necessary. Cases were a convenience sample of consecutive attendees at a 'health-check' ultrasound clinic and in selecting a matched-control for each case, the influence of an unintended selection bias cannot be entirely ruled out. Similarly, the influence of performance bias cannot be excluded as pre-baseline motivation to change groin-injecting behaviour was not assessed. Assessed behaviours were self-reported, although corroboration was obtained from clinical evidence of recent injection as recorded by doctors and care-coordinators. However, differential under-reporting is unlikely to have influenced the findings as patients were not aware of the study hypothesis. Furthermore, there were no apparent differences in the nature of contact received by cases and controls other than those relating specifically to UFV.

Our findings concur with those of studies from related fields, such as the significant positive effects for smoking cessation interventions which feedback images of arterial plaques in carotid arteries [27]. Other brief interventions or organisational interventions have been shown to be effective in a variety of settings with other addictive behaviours [25, 26, 28]. A range of cheap, portable ultrasound scanners are now available and UFV can be delivered (with minimal training and running costs) by a doctor, nurse or radiographer. Provision of UFV as part of a dedicated 'health check' service within drug clinics is feasible, safe and appears to be well received by patients and clinicians. The cost-effectiveness of UFV in this particular high-morbidity population now requires fuller evaluation.

Conclusion

A single-session UFV appears to trigger healthy behaviour change among GIs already being treated with OST. The immediate quitting of groin injecting and the size and durability of the effect observed in the present study suggest that UFV might offer a promising approach to this intractable and particularly harmful behaviour. Fuller evaluation of the benefits of adding UFV to OST programmes is now warranted in view of the potential for minimisation of groin-injecting harm, public health gains and healthcare cost savings.

Acknowledgements

We thank the Kent Drug and Alcohol Action Team (KDAAT) for providing the bulk of the GBP 23,500.00 needed for the purchase of the portable ultrasound scanner. We would also like to express our gratitude to Anton Derkacz, John Jolly, Neil Hunt, Tracey Tipping and Caroline Esposito for their support and assistance in the planning of the 'health check' ultrasound service, and to Drs. Peter White, Zelda Strydom, Omar Henriquez and Alfred Udeh and the service managers and care-coordinators involved in the care of the study subjects. John Strang is a researcher and clinician and has worked with a range of types of treatment and rehabilitation service providers. He has also worked with pharmaceutical companies to seek to identify new or improved treatments, and also with a range of governmental and non-governmental organisations. His employer (King's College London) is registering intellectual property on an innovative development in this area with which John Strang is involved. He has been named in a patent registration by a pharmaceutical company as the inventor of a potential novel overdose resuscitation product. However, these do not have any connection to the device or the intervention being investigated in this paper. A fuller account of his interests is on the personal web-page of the Addictions Department at <http://www.kcl.ac.uk/ioppn/depts/addictions/people/hod.aspx>. John Strang is supported by the National Institute for Health Research (NIHR) Biomedical Research Centre for Mental Health at South London and Maudsley NHS Foundation Trust and King's College London.

References

- 1 Hay G, Gannon M, MacDougall J, Millar T, Eastwood C, et al: Local and national estimates of the prevalence of opiate use and/or crack cocaine use (2004/05); in Singleton N, Murray R, Tinsley L (eds): *Measuring Different Aspects of Problem Drug Use: Methodological Developments*. London, Home Office, 2006.
- 2 Rhodes T, Briggs D, Kimber J, Jones S, Holloway G: Crack-heroin speedball injection and its implications for vein care: qualitative study. *Addiction* 2007;102:1782–1790.
- 3 Coffin PO, Coffin LS, Murphy S, Jenkins LM, Golden MR: Prevalence and characteristics of femoral injection among Seattle-area injection drug users. *J Urban Health* 2012;89:365–372.
- 4 Rhodes T, Kimber J, Small W, Fitzgerald J, Kerr T, Hickman M, et al: Public injecting and the need for 'safer environment interventions' in the reduction of drug-related harm. *Addiction* 2006;101:1384–1393.
- 5 Miller PG, Lintzeris N, Forzisi L: Is groin injecting an ethical boundary for harm reduction? *Int J Drug Policy* 2008;19:486–491.
- 6 Wilkins L, Bissell P, Meier PS: Risky injecting practices associated with snowballing: a qualitative study. *Drug Alcohol Rev* 2010;29:256–262.
- 7 Williams K, Abbey E: Knowledge of deep vein thrombosis among intravenous drug users. *Psychiatr Bull* 2006;30:263–265.
- 8 Irish C, Maxwell R, Dancow M, Brown P, Trotter C, et al: Skin and soft tissue infections and vascular disease among drug users, England. *Emerg Infect Dis* 2007;13:1510–1511.

- 9 Hacking L, West N: The ultrasound of intra-venous drug abuse in the groin – vascular and non-vascular complications: a pictorial review. *Ultrasound* 2009;17:6–12.
- 10 Health Protection Agency, Health Protection Scotland, Public Health Wales, and Public Health Agency Northern Ireland: Shooting up: infections among people who inject drugs in the United Kingdom 2011. London, Health Protection Agency, 2012. http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1317136882198.
- 11 Senbanjo R, Strang J: The needle and the damage done: clinical and behavioural markers of severe femoral vein damage among groin injectors. *Drug Alcohol Depend* 2011;119:161–165.
- 12 Pieper B, Templin TN, Kirsner RS, Birk TJ: Impact of injection drug use on distribution and severity of chronic venous disorders. *Wound Repair Regen* 2009;17:485–491.
- 13 Behera A, Menakuru SR, Jindal R: Vascular complications of drug abuse: an Indian experience. *ANZ J Surg* 2003;73:1004–1007.
- 14 Langendam MW, Van Brussell GH, Coutinho RA, Van Ameijden EJ: Methadone maintenance and cessation of injecting drug use: results from the Amsterdam Cohort Study. *Addiction* 2000;95:591–600.
- 15 Des Jarlais DC, Arasteh K, Perlis T, Hagan H, Heckathorn DD, Mcknight C, et al: The transition from injection to non-injection drug use: long-term outcomes among heroin and cocaine users in New York City. *Addiction* 2007;102:778–785.
- 16 Strang J, Babor T, Caulkins J, Fischer B, Foxcroft D, Humphreys K: Drug policy and public good: evidence for effective interventions. *Lancet* 2012;379:71–83.
- 17 Senbanjo R, Hunt N, Strang J: Cessation of groin injecting behaviour among patients on oral opioid substitution treatment. *Addiction* 2011;106:376–382.
- 18 Harris M, Rhodes T: Venous access and care: harnessing pragmatics in harm reduction for people who inject drugs. *Addiction* 2012;107:1090–1096.
- 19 Wise J: Everyone's a radiologist now. *BMJ* 2008;336:1041–1043.
- 20 Senbanjo R, Tipping T, Hunt N, Strang J: Injecting drug use via femoral vein puncture: preliminary findings of a point-of-care ultrasound service for opioid-dependent groin injectors in treatment. *Harm Reduct J* 2012;9:6.
- 21 Hunt N, Griffiths P, Southwell M, Stillwell G, Strang J: Preventing and curtailing injecting drug use: a review of opportunities for developing and delivering 'route transition interventions'. *Drug Alcohol Rev* 1999;18:441–451.
- 22 Marsden J, Farrell M, Bradbury C, Dale-Peppera A, Eastwood B, et al: Development of the Treatment Outcomes Profile. *Addiction* 2008;103:1450–1460.
- 23 Wang PW, Wu HC, Yen CN, Yeh YC, Chung KS, et al: Change in quality of life and its predictors in heroin users receiving methadone maintenance treatment in Taiwan: an 18-month follow-up study. *Am J Drug Alcohol Abuse* 2012;38:213–219.
- 24 Palmeteer N, Kimber J, Hickman M, Hutchinson S, Rhodes T, et al: Evidence for the effectiveness of sterile injecting equipment provision in preventing hepatitis C and human immunodeficiency virus transmission among injecting drug users: a review of reviews. *Addiction* 2010;105:844–859.
- 25 Hollands GJ, Hankins M, Marteau TM: Visual feedback of individuals' medical imaging results for changing health behaviour. *Cochrane Database Syst Rev* 2010;1:CD007434.
- 26 Zador D, Lintzeris N, van der Waal R, Miller P, Metrebian N, Strang J: The fine line between harm reduction and harm production – development of a clinical policy on femoral (groin) injecting. *Eur Addict Res* 2008;14:213–218.
- 27 Shahab L, Hall S, Marteau T: Showing smokers with vascular disease images of their arteries to motivate cessation: a pilot study. *Br J Health Psychol* 2007;12:275–283.
- 28 Feldman N, Chatton A, Khan R, Khazaal Y, Zullino D: Alcohol-related brief intervention in patients treated for opiate or cocaine dependence: a randomized controlled study. *Subst Abuse Treat Prev Policy* 2011;6:22.