Should the donor radius be plated prophylactically after harvest of a radial osteocutaneous flap: a cost-effectiveness analysis
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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Prophylactic plating of the donor radius after harvest of a radial forearm osteocutaneous flap was examined.

Type of intervention
Treatment, primary prevention

Economic study type
Cost-utility analysis.

Study population
The study population comprised 291 patients with a mean age of 60 years. They were obtained from 22 published studies of the complications of radial forearm osteocutaneous free flap. In addition, a further 9 studies on the complications of radius plating accounted for a further 620 patients (mean age 23 years).

Setting
The setting was secondary care. The economic study was undertaken in Canada.

Dates to which data relate
The probability and cost data were collected from two sources. The first was from a review of MEDLINE undertaken from 1966 to 2003. The second was a review of data and patients from another study (Thoma et al. 1999, see 'Other Publications of Related Interest' below for bibliographic details). The price year was not stated, but fees related to both 2001 and 2002.

Source of effectiveness data
The effectiveness evidence was derived from a review of completed studies.

Modelling
A decision analytic model was used to determine the expected costs and outcomes (quality-adjusted life-years, QALYs) of 25 potential health states (9 in the prophylactic plating group and 16 in the after-fracture group). The expected costs and outcomes were determined by simply multiplying the costs and QALYs of each health state by the probability that that health state would occur. The health states included successful surgery, fracture, successful plate removal for pain, plate removal with infection, plate removal with re-fracture, plate removal with a permanent nerve injury, and plate removal with a transient nerve injury.

Outcomes assessed in the review
The review identified the following complications which were input parameters in the model:

- the probability of functional impairment,
- the probability of cast fixation,
- the probability of open reduction internal fixation (ORIF),
- the probability of external fixation,
- the probability of unknown treatment,
- the probability of no treatment,
- the probability of re-fracture,
- the probability of infection,
- the probability of transient nerve damage,
- the probability of permanent nerve damage,
- the probability of pain from plate, and
- the probability of plate removal with no complications.

Study designs and other criteria for inclusion in the review
The review included all articles dealing with the radius osteocutaneous flap, radius free flap and complications of radius plating, but was limited to humans. No study design criteria were applied.

Sources searched to identify primary studies
MEDLINE was the only source reported to have been searched.

Criteria used to ensure the validity of primary studies
Not stated.

Methods used to judge relevance and validity, and for extracting data
Not stated.

Number of primary studies included
Thirty-one primary studies were included in the review.

Methods of combining primary studies
The data from all studies were pooled to improve the accuracy of the overall complication rates. The study by Thoma et al. (1999) (co-author of this current study), the largest study to date reviewing outcomes of radial osteocutaneous free flap reconstruction, was exploited more fully to provide information on the cost of care, additional complications, and treatment of complications for 9 patients who had sustained fractures of the donor radius.

Investigation of differences between primary studies
Results of the review
Pooling of the published literature led to the following:

the probability of fracture was 0.127;
the probability of functional impairment was 0.00;
the probability of cast fixation was 0.53;
the probability of ORIF was 0.47;
the probability of external fixation was 0.00;
the probability of unknown treatment was 0.00;
the probability of no treatment was 0.00;
the probability of re-fracture for closed was 0.0048;
the probability of re-fracture for ORIF was 0.0064;
the probability of infection for closed was 0.00;
the probability of infection for ORIF was 0.014;
the probability of transient nerve damage for closed was 0;
the probability of transient nerve damage for ORIF was 0.017;
the probability of permanent nerve damage for closed was 0.024;
the probability of permanent nerve damage for ORIF was 0.024;
the probability of pain from plate for ORIF was 0.44; and
the probability of plate removal no complications for ORIF was 0.127.

Methods used to derive estimates of effectiveness
The authors made assumptions to derive the estimates of effectiveness.

Estimates of effectiveness and key assumptions
The patients had a mean age of 60 and were assumed to live another 10 years with curative treatment (life expectancy of 70 years based on smoking history and actuarial data from Statistics Canada).

Harvesting of a radial osteocutaneous flap results in QALYs ranging from 9.94 (successful surgery with no fracture) to 4.89 (complications requiring plate removal and resulting in permanent nerve injury).

Measure of benefits used in the economic analysis
The measure of benefit was the QALYs. The utilities were measured through scenario-based questionnaires completed by surgeons and senior residents. Each of the 25 health states was described and a visual analogue scale (0 for death, 1 for perfect health) was used to elicit a measure of preference. The mean utility and standard deviation were calculated
for each health outcome. QALYs were calculated using the mean utility, duration of each health state and the life expectancy of the patient.

**Direct costs**
The total costs were estimated from surgeon fees, anaesthesia fees and hospital payment fees. These were used to calculate the Ministry of Health costs for both procedures, as well as the cost of treating all complications. No information on resource use (quantities) was presented. The cost data were from actual fee schedules, the sources of which included Ontario's Ministry of Health and Long-Term Care, and Budgeting Services at St. Joseph's Healthcare. Some unit cost information was also reported. This included the cost of the plate, allograft, antibiotics, physiotherapy and inpatient stays. Fees and costs pertained to the years 2001 and 2002, but no details of inflation adjustment were given. Discounting was not relevant as the costs were incurred during a short time.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
The indirect costs were not considered in the economic evaluation. Morbidity costs, such as lost productivity and leisure time, were reported to have been integrated into the utilities measurement.

**Currency**
Canadian dollars (Can$).

**Sensitivity analysis**
Best- and worse-case sensitivity analyses were performed on the most significant complications (fracture rate, cost of allograft, plate removal discomfort) to minimise error from over- and under-reporting in the literature. A Multi-way sensitivity analysis, by way of best-case scenario, was also undertaken, whereby the probability of permanent nerve damage, plate removal and fracture were reduced to give the best (lowest) cost-effectiveness ratio.

**Estimated benefits used in the economic analysis**
The health outcomes, as measured by QALYs, were 8.55 for prophylactic plating and 9.92 for treatment after fracture.

The incremental benefits (i.e. QALYs gained) for plating compared with treatment after fracture were -1.36.

**Cost results**
The total cost of prophylactic plating was Can$2,071.31, while the total cost of treatment after fracture was Can$140.52.

The incremental cost of prophylactic plating compared with repair after fracture was Can$1,930.79.

**Synthesis of costs and benefits**
An incremental cost-effectiveness ratio was not reported since the intervention (prophylactic plating) was more costly and less effective than the comparator (treatment after fracture), such that the intervention was dominated. The sensitivity analysis, where incremental costs ranged from $937 to $2,005 and incremental QALYs ranged from -1.36 to -1.41, found further evidence of this dominance.

**Authors' conclusions**
Based on the best evidence available in the literature to date, prophylactic plating of the donor radius after harvest of a radial osteocutaneous free flap is not cost-effective.

CRD COMMENTARY - Selection of comparators
The authors adequately justified their choice of the comparator, in that there were only two alternatives for treating a donor radius fracture.

Validity of estimate of measure of effectiveness
The analysis of the effectiveness was based on data derived from the literature, although it was unclear whether the authors conducted a systematic review of the literature. The source searched was reported but further details, such as the search terms, were not. The authors failed to fully describe the primary studies that provided evidence, and more discussion on how they pooled the data to give probability estimates is required. These issues tend to limit the internal validity of the analysis.

Validity of estimate of measure of benefit
The benefit measure (QALYs) was derived using the expert opinion of health care professionals. As the authors discussed, it is preferable to obtain utilities prospectively from patients or the general public. However, because this is a new invention and this information was not available, it was appropriate to use experts.

Validity of estimate of costs
The authors explicitly stated the perspective adopted in the study. It appears that all the cost categories have been included in the analysis. However, there was no explicit breakdown and detail of the resource use quantities and unit costs, thus limiting the possibility of replicating the study in other settings. The source of the cost (expenditure) data was reported. The data were from a number of years, however there did not appear to have been any adjustment for inflation in the analysis.

Other issues
The issue of generalisability was not directly addressed. The authors acknowledged the limitations of their study. For example, the complication rates used had been derived from a younger healthier population and, consequently, might have been an underestimation of the true rate in their population. In addition, the authors highlighted the fact that the pooled fracture rate included a number of studies published in the early eighties. The rate was found to be decreasing towards zero in the later studies, as techniques had improved. The authors appear to have presented their results in full, although, the readability of the paper would have been enhanced if the decision tree had been reproduced.

Implications of the study
The authors recommended the treatment of donor radius fractures after they occur.

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None stated.

Bibliographic details

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Other publications of related interest

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