THE SURGICAL TREATMENT OF CUBITAL TUNNEL SYNDROME: A DECISION ANALYSIS

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The objective of our study was to use decision analysis to compare four common surgical treatments for cubital tunnel syndrome: simple decompression of the cubital tunnel, medial epicondylectomy, anterior subcutaneous transposition and anterior submuscular transposition. The variables used for this decision analysis model were based on data from the literature. Extensive sensitivity analyses were carried out to test the impact of the values given to these variables on the outcome of the model. The highest expected utility, 0.973, was associated with simple decompression. The expected utility was 0.969 for subcutaneous transposition and 0.965 for submuscular transposition. Medial epicondylectomy had the lowest expected utility at 0.961. Simple decompression remained the preferred strategy in extensive one-way sensitivity analyses.
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Compression of the ulnar nerve at the cubital tunnel is the most common cause of numbness on the ulnar side of the hand and, after carpal tunnel syndrome, the second most common compressive neuropathy affecting the upper extremity (McPherson and Meals, 1992; Rayan, 1992; Idler, 1996). Failure of non-operative treatment for this condition may be an indication for surgery. However, the best operative intervention remains controversial (Dellon, 1989; Mowlavi et al., 2000; Lowe et al., 2001). The most commonly performed operative procedures each have advantages and disadvantages (Table 1) and all have been shown to be associated with both satisfactory and poor outcomes (Dellon, 1989; Osterman and Davis, 1996; Posner, 2000; Lowe et al., 2001). There have been few well-executed randomised trials comparing these procedures reported in the literature and none that make a direct comparison of more than two of the possible surgical interventions. Issues of varying case definitions for cubital tunnel syndrome, inconsistencies in identifying the stage of the condition and the absence of an established consensus on measuring the outcome of treatment limit the feasibility of a convincing randomised trial (Graham, 2005) comparing treatment with the four most common surgical treatments used in this condition, viz. simple decompression of the cubital tunnel, medial epicondylectomy, anterior subcutaneous ulnar nerve transposition and anterior submuscular ulnar nerve transposition.

The objective of our study was to use decision analysis to compare these four interventions.

MATERIALS AND METHODS

Decision analysis models

Implicit in the process of clinical decision-making is the evaluation of risk and benefit associated with the various choices available for management. When actual evidence to guide clinicians in their decisions is either conflicting or completely absent, the element of uncertainty is more than usual. Decision analysis allows a quantitative comparison of the various options for addressing a clinical problem (Kassirer, 1976; Detsky et al., 1997a, b).

A decision analysis attempts to consider all possible outcomes of a given strategy. The probability that any particular outcome will occur is estimated from the literature. The value of a given outcome is expressed in terms of *utility*, which is a measure of the desirability of the health state encompassed by that outcome (Torrance, 1987). Utility for a health state is expressed on a scale of 0 to 1.0, where 0 represents death and 1 represents perfect health. Techniques such as the standard gamble and the time tradeoff can be used to establish the utility of different health states (Naglie et al., 1997; Torrance, 1987; Sox et al., 1988). Some examples of the utility associated with various health states that have been reported previously in the literature are listed in Table 2. The decision analysis model establishes which strategy is associated with the highest expected utility and, thus, helps guide clinicians towards the best clinical policy for a particular clinical problem.

The concept of *disutility* is the converse of utility and represents a transient health state that temporarily downgrades the quality of life. For the example of cubital tunnel syndrome, disutilities would include perioperative discomforts and inconveniences, such as hospitalisation and immobilisation. A disutility can also be established for the complications specific to each treatment. For example, a haematoma, or having to drain a wound, would be a temporary state associated with quantifiable disutility. The disutilities associated with any of the short-term states during treatment are subtracted from the utility associated with each

Table 1—A summary of the major advantages and disadvantages of simple decompression, decompression with medial epicondylectomy, anterior subcutaneous transposition and anterior submuscular transposition of the ulnar nerve

Procedure	*Advantages*	*Disadvantages*
Simple decompression	Uncomplicated technique No immobilization Small scar	Mild perioperative morbidity • Surgical site tenderness • Nerve position not changed
Medial epicondylectomy	Prominence eliminated	Moderate perioperative morbidity • Surgical site tenderness • Risk of medial instability of elbow • Risk of ectopic bone formation • Nerve tension not changed • Postoperative immobilisation required
Anterior subcutaneous transposition	Tension on nerve reduced by new position	Moderate perioperative morbidity • Surgical site tenderness • Postoperative immobilisation required • Greater surgical scarring • New nerve position superficial
Anterior submuscular transposition	Nerve repositioned to well-perfused, protected position without tension required	Moderate perioperative morbidity • Surgical site tenderness • Postoperative immobilisation • Greater surgical scarring • Demanding technique

Table 2—Utility of different health states

Condition	*Utility*
Menopausal symptoms	0.99
Side effects of anti-hypertensive treatment	0.95–0.99
Wrist arthrodesis	0.95
Kidney transplant	0.84
Hospital dialysis	0.57
Severe angina	0.50

Torrance, 1987; Graham and Detsky, 2001.

treatment. For example, the overall expected value of a procedure such as medial epicondylectomy would be: the utility of the procedure (the desirability of the postoperative state of a surgical scar and bone removal combined with a complete relief of symptoms), minus the disutility of the procedure (surgical wounds, perioperative pain, hospitalisation, immobilisation, etc.) and minus the disutility of any complications of the procedure (the negative impact of complications such as medial instability or ectopic bone formation occur) if they should occur.

Important undesirable consequences of treatment that are permanent are not accounted for as disutilities, but rather as a decreased utility associated with a health state. To take the example of medial epicondylectomy again, the outcome from the standpoint of the relief of sensory symptoms might be considered good, but the utility of that health state might be decreased by the co-occurrence of permanent elbow stiffness, in comparison with a health state characterised by a full relief of sensory symptoms and normal elbow motion.

Decision analysis models have two additional features that make them particularly useful where actual evidence to support one clinical strategy over another is not available. First, the explicit nature of the model makes it clear which assumptions were made, so that the reader can determine whether these seem valid. Second, the model allows a sensitivity analysis to establish the stability of the conclusions reached by the analysis. In a sensitivity analysis, each variable in the model is varied throughout the entire range of its possible values to determine whether the conclusion suggested by the model is sensitive to the value of one or more important variables. If changing the value of a certain variable changes the outcome of the model, e.g., a different treatment strategy becomes preferred, then the model is sensitive to that variable. For example, the model may indicate that surgical treatment A is recommended over surgical treatment B when the probability of a postoperative infection is 1%, but